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**REPORT
ON
CANCER OF THE RECTUM**

An analysis of the literature with special
reference to the results of operation



MINISTRY OF HEALTH

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PREFATORY NOTE BY THE CHIEF MEDICAL OFFICER.

The Rt. Hon. NEVILLE CHAMBERLAIN, M.P.,
Minister of Health.

SIR,

In pursuance of the plan adopted of assessing the value of treatment in cancer at sites lending themselves to this form of investigation, the Departmental Committee on Cancer,* having previously undertaken statistical inquiries into cancer of the breast and uterus†, decided to proceed to an inquiry relating to the rectum. They were guided in their choice of this site by its relative frequency in males and females, its comparative accessibility both for diagnosis and treatment and by the fact that the rectum forms part of the digestive tract, in which occurs the largest proportion of all deaths registered as due to cancer.

For the preparation of the report the Committee are indebted to Dr. F. J. Darbyshire, who examined and abstracted the literature, and have greatly appreciated the assistance given by the Surgical Statistics Sub-Committee, Dr. Lane-Claypon, and Professor Greenwood.

The report is based on the examination of rather less than 6,000 cases of cancer of the rectum in which operations for radical cure were performed in 10 different countries. When compared with the 80,000 cases of cancer of the uterus and the 25,000 cases of cancer of the breast reviewed by Dr. J. Lane-Claypon in two previous reports‡ the sample dealt with in the present instance appears very small, but it was considered of sufficient size to form the basis for

* Terms of Reference.—“To consider available information with regard to the causation, prevalence and treatment of cancer, and to advise as to the best method of utilizing the resources of the Ministry for the study and investigation of these problems.”

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† Ministry of Health. Reports on Public Health and Medical Subjects Nos. 28, 32, 33, 34 and 40.

‡ Ministry of Health. Reports on Public Health and Medical Subjects Nos. 28 and 40.

deductions of some utility. The findings of the inquiry are briefly as follows :—

- (a) On the average a period of 12 months was allowed to elapse between the occurrence of the first symptom of the disease and the patient coming to operation.
- (b) Rather less than half the cases when seen by the surgeons were considered to be operable.
- (c) About a sixth of all the patients who underwent a radical operation died as the result of such operation or from causes connected with it. There is no doubt, however, that it should be possible to secure a considerably lower operative mortality at the present time.
- (d) There is evidence, though limited, to shew that the mortality from operation was much higher than the average among those patients who are in an advanced stage of the disease.
- (e) Two out of every five of those submitted to radical operation were alive three years afterwards.

These findings, though more restricted in their scope than those which have emerged from the investigations into cancer at other sites, are, I think, of sufficient importance to furnish justification for the publication of this report. In this opinion I am confirmed by the evidence found during the inquiry of the wide divergencies of opinion among surgeons with regard to the possibilities of operative treatment in cancer at this site. The inquiry has moreover provided an opportunity of testing certain opinions widely held on points which, if less important than those referred to above, present considerable interest. Thus the general opinion of surgeons as to the high operability in women as compared with men has been confirmed, whereas no evidence has been forthcoming to ratify the common belief that cancer of the rectum is of graver import in young persons than in older ones, a result which is in agreement with that obtained in the inquiry into cancer of the uterus.

Another point which has emerged is the frequency with which pain is an early symptom of this disease. With the exception of irregular action of the bowels, it is the commonest first indication. This result is of considerable interest in view of the fact that cancer is often referred to as being initially a "painless disease," and it recalls the comparative frequency with which pain is also complained of in cancer of the breast, as has been shewn in a previous report.* This should encourage us in the hope that education of the public conducted on appropriate lines may bring to treatment in an operable stage of the disease a number of cases which are at present only detected when the disease has advanced too far for intervention.

Regret may perhaps be felt that it has not been possible to treat more fully other aspects of the subject, such as the influence exerted on

* Ministry of Health. Reports on Public Health and Medical Subjects No. 32.

the prospect of cure by the stage of the disease at which operative treatment is undertaken, the outlook for the patient in terms of comfort and the carrying on of normal life, the value of radiological treatment and similar matters. These points must, however, await the collection of further data for their elucidation. In the meanwhile there are ample indications as to the lines along which progress may be made in the control of cancer at this site, namely (*a*) the recording in future cases by the surgeons concerned of full details, such as are indicated in this report, in order to provide them with those complete data upon which alone the rational treatment of the disease can be founded, (*b*) the education of the public and of the medical profession in those already established facts which will conduce to discovery and treatment of the disease while there is still hope of permanent cure, and (*c*) the development by all suitable means of those facilities for diagnosis and treatment which have proved effective in the past.

I have the honour to be,

Sir,

Your obedient servant,

GEORGE NEWMAN.

WHITEHALL, S.W. 1.

December, 1927.

REPORT ON CANCER OF THE RECTUM

An analysis of the literature with special reference to the results of operation.

I. INTRODUCTION.

Object of the Investigation.

The investigation into the literature of the surgery of cancer of the rectum has followed mainly the lines adopted by Lane-Claypon for cancer of the breast.*

In both cases a very desirable object of an analysis of the literature would be to measure the advantage, whether in terms of increased duration of life or mitigation of suffering, enjoyed by those who submitted to operation. In cancer of the rectum, however, the heavy operation mortality is a complicating factor not present in the treatment of cancer of the breast, and the physiological relationship of the rectum to the whole organism introduces peculiar problems.

It is clear that it would be desirable, were it possible, to tabulate the data into as fine categories as for cancer of the breast. But the total number of recorded cases of cancer of the rectum collected for the purpose of this report is under 6,000, compared with more than 25,000 available in the case of the breast. Hence the expression in numerical terms of answers to practical questions is in some instances of doubtful value because of the possible error resulting from the use of small numbers.

The Scope of the Literature.

The literature utilised is fairly extensive. It originates in the following countries, England, America, France, Germany, Austria, Hungary, Czecho-Slovakia, Belgium and Scandinavia.

Some papers are not available in this country, but it is improbable that important publications have escaped quotation by some or other author either in the country of publication or a foreign one, hence few figures of importance can have escaped notice.

* Reports on Public Health and Medical Subjects No. 28. Ministry of Health. 1924.

There was little radical treatment of cancer of the rectum before 1885 and most of the literature therefore has appeared since that date. Systematic publication of results, as in the case of cancer of the breast, has been common chiefly in connection with continental clinics and great care has usually been exercised in tracing patients after operation.

The Method of the Investigation.

It was decided to use the following schedule as a basis for the analysis of papers :—

1. Author of paper. Title. Source.
2. Surgeon. Place of work. Dates.
3. No. of cases quoted.
4. Age of patients. Sex. Occupation. Past history. Family history. Civil state.
5. Symptoms complained of. Duration of trouble. Previous treatment. Commonest symptom.
6. Signs on examination. Character of tumour (position, size, etc.). Method of examination, *e.g.* finger, sigmoidoscope, microscope, etc.
7. Nature of operation and if colostomy done. What removed. Anæsthetic used.
8. Operative mortality and cause of death.
9. Post-operative procedure and treatment.
10. Fate of patient, *e.g.* recurrences, period of immunity.
11. State of patient after operation, *e.g.* post-operative disability, function, permanent cure, &c.
12. Other points.

Very few papers furnish all these items.

The Limitations of the Data.

At the outset of all investigations of this nature one is met by the confusion due to the various senses in which the same term is employed by different authors, the great variety of operative methods in use—even well established methods being constantly modified to accord with advances in surgical knowledge or with the experience of the surgeon—the different methods of describing the position and character of the growth, the frequent neglect of authors to give important particulars of their cases and the lack of uniformity in stating the end results of operative treatment. These sources of confusion are very apparent in the present case. For example, as is shown in Section III of the report, the term "operability" is evidently employed by different authors in widely different senses, but in many instances no indication is given of the exact sense in which this term is employed, whilst very often the operability of the cases is not given nor information from which

this important factor can be calculated. Again the very great importance of stating, as exactly as possible, the position of the growth in the long axis of the rectum does not seem to have been realised by most authors, with the result that this point could only be determined in about a third of the total cases of radical operation. The importance of this omission becomes plain when one reflects that cancer in the three main divisions of the rectum varies so greatly in its symptoms, microscopical characters, malignancy and prognosis, that it is regarded by many experienced observers as three separate diseases. It would consequently have been most desirable, had the data allowed of this, to have separated the cases throughout the report according to the position of the growth, but in most instances this has been impossible.

Anatomical Area dealt with.

Some authors prefer to include growths of the terminal part of the pelvic colon with those of the rectum as delimited at the present day. Thus Morton at Liverpool, 1912, said, "It seems to me impossible in discussing the subject (cancer of the rectum) to separate growths in the lower part of the pelvic colon and growths in the rectum proper." Similarly W. J. Mayo, in 1916, wrote "Cancers which involve the upper rectum cannot be separated surgically from cancer of the terminal sigmoid." Therefore, he goes on to say, he classifies high rectal and terminal sigmoid cancers in one group as rectosigmoid cancers. Depage and Mayer support this view and adopt the same grouping.

In stating the distance of the growth from the anal margin, some authors make use of standard units of length, others employ such descriptions as "within reach of the finger," or "high up," "low down," "extensive," "at the junction of the rectum and sigmoid," "ano-rectal," "ano-ampullary," "ampullary," "in the anal canal," "in the lower rectum," &c.

In the present report growths of the pelvic colon and rectum proper have been considered together. A classification of tumours according to position has, however, been adopted which will to some extent correspond with the usual description in the literature, being based on the findings of clinical examination. Cripps, for example, mentions that in ordinary circumstances the finger can explore to a distance of 4 to 5 inches from the anus. It seems desirable in view of this fact to adopt, for purposes of more effective comparison of results of operation, a grouping of tumours according to distance from the anal margin. The grouping chosen is artificial but corresponds approximately to anatomical segments of the gut: thus the first group, described as "low," refers to the area lying within $1\frac{1}{2}$ " of the anal margin, i.e. in general the anus and anal canal; the second "middle," to that between $1\frac{1}{2}$ " and $4\frac{1}{2}$ " of the anus and therefore takes in the ampulla and anything within reach of the examining finger;

finally the third group "high," comprises those more than $4\frac{1}{2}$ " from the anal margin, including the rectosigmoidal junction.

Although it may appear that the position of the upper margin of the growth is at least of equal importance to that of the lower, precise definition of the former limit rarely appears, *e.g.* Kupferle includes amongst his headings in detailing his series of 238 patients the items upper and lower limits. However, in only 20 of the 238 cases does the position of the upper margin appear, the remainder being described as *erreichbar* (within reach), *nicht erreichbar*, &c. The position of the lower margin, however, is quoted definitely in almost every case. In many other reports no note is made of the position of the upper limits.

Besides the above grouping into "high," "middle" and "low" growths another classification has been employed in which the growths are grouped according to their position on the circumference of the bowel, *i.e.* (1) posterior, (2) anterior, 3) annular growths.

II. CHIEF TYPES OF RADICAL OPERATION.

Present day operative treatment of the rectum, intended to be of a radical nature, may be classified according to the mode of approach to the rectum adopted by the surgeon.

The chief types are :—

- (1) Perineal,
- (2) Sacral,
- (3) Combined, *i.e.* an abdominal operation combined with a perineal or sacral one.

In addition there is less often excision of the growth by way of either the anus or the vagina, or again by the purely abdominal route.

Below is a table showing the relative frequency of the chief types in various principal countries.

TABLE I.

* Frequency of the chief types of "radical" operation in various countries.

Country.	Total "Radical Opera- tion."	Perineal	Sacral	Com- bined.	Abdomi- nal only.	Anal or Vaginal.	Not stated.
England ...	573	344 60·0%	97 16·9%	51 8·9%	6 1·0%	—	75 13·1%
France ...	169	65 38·5%	5 2·9%	52 30·8%	1 0·6%	1 0·6%	45 26·6%
Belgium ...	41	30 73·1%	2 4·9%	—	—	—	9 21·9%
United States	1,255	137 10·9%	78 6·2%	127 10·1%	20 1·6%	20 1·6%	872 69·5%
Switzerland	181	145 80·0%	29 16·0%	5 2·8%	1 0·6%	1 0·6%	—
Germany ...	1,673	542 32·4%	864 51·6%	129 7·7%	2 0·1%	50 2·9%	86 5·2%
Hungary ...	188	22 11·7%	154 81·9%	8 4·3%	—	—	4 2·1%
Austria ...	1,289	21 1·6%	1197 92·9%	54 4·2%	—	5 0·4%	12 0·9%
Czecho- Slovakia ...	193	45 23·3%	2 1·0%	—	—	—	146 75·6%
Scandinavia	193	4 2·1%	17 8·8%	12 6·2%			160 82·9%

1. Perineal Operation.

Lisfranc is regarded as the originator of the perineal method, which he introduced in 1826. His procedure consisted in a simple circular amputation of the anal canal and, although restricted, the operation was at the time regarded as a bold step. In 1873 Verneuil proposed the resection of the coccyx which was afterwards adopted by Kocher in developing the technique of the operation bearing his name.

With the development of antiseptic and aseptic surgery the opening of the peritoneum from below came to offer no serious

* A series of 116 cases of combined operation (which includes the 42 considered in this report) has recently been published by Miles, too late for inclusion in this report.

danger, and the field of the perineal operation became wider than in Lisfranc's day. To-day some operators carry out a preliminary laparotomy to ascertain the condition of the lower abdomen before definitely deciding to proceed to a perineal operation. Colostomy is recommended by some, either with or without exploring the abdomen.

Some authors consider the resection of the coccyx as a bony operation and class it with sacral operations. Others, however, maintain that it is much more a perineal operation than a sacral one.

Mummery is one of the strong advocates in this country of the perineal operation. He performs a preliminary colostomy through the left rectus under gas and oxygen, at the same time making an exploration of the abdominal cavity. The colostomy is opened after two days, and about a week or ten days later the perineal operation is carried out under sacral anaesthesia. The rectum is amputated and the abdominal stump of the gut invaginated and sutured. The peritoneum previously opened is then closed. He states that he removes the sigmoid and its mesentery, anus and perianal skin, together with the contents of the ischio-rectal fossa and parts of the levatores ani.

The amount of tissue removed in Mummery's operation is more than in Lisfranc's procedure; in fact it is maintained by some that it is possible to remove the affected tissue as completely by the perineal route as by any other.

Miles' experience of perineal operations, given in the section under Combined Operation, led him to adopt the combined operation in preference to the perineal.

Several French authors advocate the perineal operation, especially for low seated growths.

In Belgium Depage was a supporter of the perineal method. In America, Lynch, reporting for Tuttle, says he considers the perineal operation to be the operation of choice in fat or debilitated patients.

In the Swiss literature the perineal method without resection of the sacrum occupies the most important place.

In German, as in Austrian publications, the perineal operation finds little place, for the majority are concerned with sacral procedures.

Kupferle, of Czerny's Clinic, Heidelberg, published in 1904 a report dealing with 238 cases of radical operation, period 1877-1902. He pointed out that in his series the perineal method was used for cancers the lower margins of which were in close proximity to the anus and reached only a few centimetres upwards into the rectum. However, he remarks that the original perineal methods were increasingly replaced by the Kocher* and Kraske* operations.

* Kocher removed the coccyx, and Kraske part of the sacrum in the course of their respective operations.

The sacral method was utilised when the tumour extended high above the sphincter and also in those cases in which resection was intended. Again, when the cancer had become adherent to surrounding structures the sacral method provided a better opportunity of controlling bleeding.

2. Sacral Operation.

Sacral operations date from 1885, when Kraske before the 14th Congress of the German Surgeons described the operation now associated with his name. The occasion was epoch-making, for a means was supplied of reaching growths highly placed in the rectum.

The method is still popular in both Germany and Austria, but not in France, where, although at first there were warm supporters, opinion is nowadays rather set against it. For example, Quénau has said that experience of Kraske's technique and of the inconveniences which it brings in its train has led to his abandoning it.

In America, the Mayos and others have used the method fairly frequently in the past and similarly in England a few surgeons have practised it, but in neither country has it the same vogue as in Germany and Austria.

Out of nearly 6,000 cases of radical operation recorded in the literature, about 42 per cent. are operations in which the sacrum was resected or reflected.

The introduction of Kraske's technique gave considerable impetus to rectal surgery and there followed a series of modifications of his method.

Temporary reflection of the sacrum or an osteo-integumentary flap operation received attention. Heincke in 1888 was probably the first surgeon to employ a method of this kind.

3. Combined Operation.

The published statistics of this operation are scanty chiefly because the method is of comparatively recent development. Although Volkmann may be said to have envisaged the operation in a work on removal of the cancerous rectum in 1877 it was not until the '90s that the method received much attention in print. From that time the technique has gradually become more precise, though varying according to the modification practised. The varieties of combined operation in vogue at the present day may be named thus :—

- (a) Abdomino-perineal
- (b) Abdomino-sacral
- (c) Abdomino-anal
- (d) Abdomino-vaginal

Some surgeons strongly advocate the use of the combined operation for every type of case, whilst others reserve it for particular

types. Originally the operation was devised in order to reach high growths either of the rectum or of the pelvic colon. It was used too for those cases in which the cancerous condition was well advanced and the tissues surrounding the rectum or the lymphatic glands were so far involved that the perineal or sacral operation presumably gave small prospect of permitting complete extirpation of the disease. Lately the advocates of the method justify it on pathological grounds and consider it as rational in the case of the rectum, as the "complete" operation is in the case of the breast.

In some quarters in France the combined method has received strong support.

Turning to German sources one finds several series of combined operations recorded. Opinions vary widely as to the value of and indications for the method. Reports emanating from other countries deal very scantily with it.

W. J. Mayo in America, while not giving preference to any one particular type of operation, has practised the combined operation on many occasions; so have other American surgeons such as Tuttle, Gant, and Coffey.

Mayo in 1912, contrasting the various methods of operation stated that "in the elderly, in the very obese patient, and in poor surgical risks, operations in one stage through the perineum or posteriorly (sacral) should be practised. The sacral operation either as a primary operation or as the second stage of the abdomino-sacral method is the operation of choice for the actual removal of the rectum."

III. OPERABILITY.

1. Definition.

Having diagnosed cancer of the rectum the surgeon has to decide whether the disease can be extirpated by what he regards as a "radical operation."

The condition of the patient in which, in the opinion of the surgeon, such a result can be achieved constitutes his "operability"; the "index of operability" for any particular surgeon should therefore be the ratio of the number of cases *recommended* for radical operation to the total number of cases observed by the surgeon. Owing, however, to the form in which the data are usually presented in the literature the numerator of the above fraction usually employed is the number of patients actually submitting to radical operation; and even this figure is not always available as the surgeon frequently fails to record the total number of cases which he has observed, thus giving an inaccurate denominator as well. It is believed, however, that the error due to the first of these causes is negligible.

The cases which are apt to be omitted from the total number of cases observed are those which on first examination are found to

be hopelessly inoperable and also probably some which are referred elsewhere for palliative treatment. This source of error may be important but it is quite impossible to determine its magnitude.

2. Standards of Operability.

The standard of operability in general has gradually improved as the technique of the various radical operations has been perfected. The same appears to be true for individual surgeons. Thus Cripps' estimate of the operability of all his cases varied from 20 per cent. in 1876 to 30 per cent. in 1907. As the technique improved so did the scope of the operations become wider and the contraindications more limited. In 1887, Cripps regarded the inability of the surgeon to feel healthy bowel above the growth during examination per rectum as an absolute contraindication to operation, and Jessop, writing in 1889, took the same view. Moreover, Cripps required in addition that the bowel should be fairly movable, while Jessop would not operate in the male when the disease affected the anterior wall of the rectum.

Ball in 1903 still regarded free mobility of the rectum as an essential criterion of operability but did not hesitate to operate upon highly placed growths. He did not regard limited adhesion to the vagina or pelvic diaphragm as a contraindication but did so regard involvement of the prostate, bladder or uterus or wide involvement of the lateral or posterior aspects of the pelvis. In 1911 Lockhart Mummery was only excluding cases on the grounds that metastases were present or important structures involved that could not be removed. Chalier and Mondor in 1924 regarded the fixation of the rectum as the chief contraindication to operation, the height of the growth being of minor importance.

It may be pointed out here that several authors consider that fixation of the rectum may be due entirely to inflammatory changes, such fixation being often clinically indistinguishable from that due to cancerous infiltration. In support of this opinion they state that colostomy has been followed by restoration of the mobility of the rectum, presumably owing to diminished irritation by septic material.

There are in fact even now no generally accepted criteria of operability, each surgeon being guided largely by his personal experience and the type of operation which he practises.

3. Operability for Various Countries.

In Table 2 the evidence in the literature as to operability is grouped under the country of origin. The figures for Austria, Hungary and Czechoslovakia are small and have been combined under the head of "Other Countries." The figures for the individual surgeons will be found in Table 30, Appendix I.

TABLE 2.

Mean Operability for Various Countries.

Country.	No. of Authors.	Total No. of cases seen.	No. of cases Operable.	Operability.
England	4	1,312	498	38
United States	4	1,118	678	61
Switzerland	4	337	119	35
Germany	11	2,000	953	48
Scandinavia	3	162	89	55
Other Countries	3	302	202	67
Totals	29	5,231	2,539	48·5

In view of the fact that some of the data used in compiling the above table are more than 50 years old the differences between the mean operabilities for the various countries are less than might have been expected.

4. Operability in Relation to Sex.

There appears to be general agreement among surgeons that the mean operability is higher for women than for men. The following figures bear out this contention.

	Men.		Women.	
	Per cent.	Per cent.	Per cent.	Operable.
Woelfler ... ...	... 43	... 53	... 84	"
Prutz ... ...	... 43	... 66·3	... 70·6	"
Kocher ... ...	... 53·5	... 68·4	... 68·4	"
Chalier and Mondor				

This advantage of females over males is said to be due to the greater roominess of the female pelvis and its superior resistance to infection (cf. Table 7, p. 14). In the male the close proximity of the anterior wall of the rectum to the prostate and bladder results in the frequent involvement of these structures in growths situated on the anterior wall, and the difficulties and dangers attending dissection of this wall from the structures in front have caused French authors to name it the *face dangereuse*.

5. Operability in relation to Age.

No reliable evidence has been found bearing on the relation of operability to the age of the patient at the time of operation.

IV. OPERATIVE MORTALITY.

1. Definition.

When the deaths during the first year after operation are set out month by month it is found that a far larger number occur during the first month than during any one subsequent month (*v. Appendix XI, Tables 50, 51*). Some surgeons, however, do not state precisely which of the deaths they regard as directly attributable to the operation. In this report, therefore, a death has been considered an "operative death" if (1) it is so stated by the author, or, in the absence of any such statement, (2) it occurs within one month of operation.

2. General.

On this basis it has been found (*v. Table 30, Appendix I*) that for a total number of 5,240 recorded cases of radical operations of all types the number of operative deaths was 866, *i.e.*, the operative mortality was 16·5 per cent.*

In Table 3 these data are set out according to the country of origin.

TABLE 3.
Operative Mortality for Various Countries.

Country.	No. of Authors.	No. of cases operated upon.	No. died from operation.	Operative Mortality.
				Per cent.
England	9	659	80	12·1
France	8	170	25	14·7
United States	6	839	124	14·8
Belgium	2	41	11	24·4
Switzerland	6	181	37	20·4
Germany	19	1,782	356	20·0
Austria	8	994	148	14·9
Hungary	2	188	17	9·0
Czecho-Slovakia	2	193	42	21·8
Scandinavia	4	193	26	13·5
Totals	66	5,240	866	16·5

3. In relation to Sex.

In a series of 1,398 radical operations of all types the 860 males operated upon gave an operative mortality of 18·9 per cent. whilst

* A series of 116 cases of combined operation (which includes the 42 considered in this report) has recently been published by Miles, too late for inclusion in this report. The figure for the operative mortality of the total series given above would not be affected by the inclusion of these additional cases.

for 538 females the operative mortality was 15·0 per cent. (*v.* Table 4).

When this series is analysed with regard to the type of operation performed, as has been done below in Table 4, this general advantage of females over males is seen to hold good for patients submitted to the perineal or the combined operation, but in sacral operation the operative mortality is practically the same for the two sexes.

4. In relation to the Type of Operation.

Table 4 shows the operative mortality for the three main types of operation of the series of 1,398 cases just considered.

TABLE 4.

Operative Mortality for the Chief Types of Operation for the two Sexes.

Type of Operation.	Both Sexes.			Males.			Females.		
	Operated upon	Died from Operation.	Operative Mortality.	Operated upon	Died from Operation.	Operative Mortality.	Operated upon	Died from Operation.	Operative Mortality.
Perineal ...	602	105	17·4	361	73	20·2	241	32	13·3
Sacral ...	696	107	15·4	430	65	15·1	266	42	15·8
Combined ...	100	32	32·0	69	25	36·2	31	7	22·6
Totals ...	1,398	244	17·5	860	163	18·9	538	81	15·0

The patients submitted to the combined operation were very few compared with those undergoing operations of other types, but if it be assumed that they are numerous enough for purposes of comparison then it will be seen that the operative mortality for both sexes together is heaviest in the case of the combined operation and lightest in the case of the sacral operation, the perineal operation being intermediate. Considering the two sexes separately, however, it is seen that though this order holds good for males the lowest operative mortality for females belongs to the perineal operation rather than the sacral.

5. In relation to the Site of the Growth.

In Table 5 the operative mortality is given for 1,769 cases divided into three classes according to the distance of the lower edge of the growth from the anal margin.

TABLE 5.

Operative Mortality in relation to Site of Growth.

Site of Growth.	Total No. of cases.	Percentage at this site. Per cent.	Died from Operation.	Operative Mortality. Per cent.
Low i.e. lower edge of growth within $1\frac{1}{2}$ " of anal margin ...	550	31.09	67	12.28
Middle i.e. lower edge of growth between $1\frac{1}{2}$ " and $4\frac{1}{2}$ " from anal margin ...	1,004	56.76	168	16.79
High i.e. lower edge of growth more than $4\frac{1}{2}$ " from anal margin	215	12.15	55	25.50

According to the experiences set forth in this table the higher the growth the higher the operative mortality. The heavy mortality for "high" growths may be due to the employment in these cases of a more extensive type of operation, sometimes involving laparotomy and in any case associated with increased risk of sepsis and shock. Sufficient data to verify the truth of this supposition are not, however, available.

6. In relation to the Stage of the Disease.

The only data in the literature of sufficient size numerically to give any indication of the relation of operative mortality to the stage of the disease at operation are those of Lockhart Mummery, which are set forth in Table 6.

TABLE 6.

Operative Mortality in relation to the Stage of the Disease.

Class of Case.	Total No. of cases.	Died from Operation.	Operative Mortality.
All classes of case	200	17	8.5
A	73	0	0.0
B	96	9	9.4
C	31	8	25.8

Class A.=Very favourable cases where the growth was small and had not apparently invaded the muscular coat and no glands were involved.

Class B.=Medium cases where there was involvement of the muscular coat, but where the growth was not unduly fixed and there was no extensive involvement of glands.

Class C.=Very bad cases where the growth was large and fixed, or where there was evidence of extensive involvement of glands. These were borderline cases with a bad prognosis.

The much heavier operative mortality for cases in an advanced stage of the disease at the time of operation than for cases treated earlier is in accordance with the findings for cancer of the uterus.*

7. Immediate Causes of Operative Deaths.

Table 7 shews the relative frequency of the principal immediate causes of operative deaths and deals with 452 operative deaths out of a total of 511.

TABLE 7.

Immediate Causes of Operative Deaths.

Immediate Cause of death.	Total No. of Deaths due to this cause.	Percentage of total (511) Operative deaths.	Males.	Females.
			Per cent.	
Sepsis	233	45·6	84	48
Shock and Collapse ...	137	26·8	34	31
Pneumonia and Lung Complications	50	9·8	18	11
Embolism	23	4·5	0	6
Disorders of the Urinary System	9	1·8	5	0

NOTES.

(1) In the above table "Sepsis" includes Sepsis, Septicaemia, Peritonitis and Pyaemia. "Shock and Collapse" includes collapse, bleeding, marasmus, anaemia, ileus, heart failure and exhaustion. "Disorders of the Urinary System" includes pyelitis, pyelonephritis, cystitis and uraemia.

(2) It will be noticed that the figures in the second column are not the sum of the corresponding figures for males and females. This is due to the inclusion in the second column of a series of 215 operative deaths for which the sex of the patient is not given in the literature.

(3) The percentage of the total operative deaths due to the different causes considered has not been given for the two sexes separately owing to the smallness of the numbers in the last two columns.

According to the experiences set out in this table "Sepsis" is by far the most important immediate cause of operation mortality, being responsible for nearly half the deaths from operation. The next most important cause, "Shock and Collapse," only accounts for a little more than half the number of deaths due to "Sepsis." With regard to the influence of sex in this connection the only comparison that comes out clearly from these figures is the much

* Reports on Public Health and Medical Subjects No. 40. Ministry of Health, 1927.

higher mortality from "Sepsis" in males than in females. This, it is generally believed by surgeons, will account for a part at any rate of the more favourable late results obtained with females (*v.* next section).

V. FATE OF PATIENTS SUBMITTED TO RADICAL OPERATION.

1. Influence of Operation on Survival.

(a) *General.* The deaths which are presumably attributable to the effects of operation have been dealt with in the previous section, and it is now necessary to consider the fate of those who, having been operated upon, have survived the operation, and to ascertain what proportion of them are still alive after a given period. The simplest method of setting out the results is to deal only with patients who have been operated upon prior to any given date, usually either three or five years before the time of writing. If the fate of these patients is known the procedure is easy. In the present case the available data do not all conform to the above requirements. Although some surgeons offer data on these lines, in other instances the series of patients examined extend over varying periods since operation, including some who have been operated upon within three years of the time of writing up the results. In addition, not all patients have been traced, so that the fate of a part of the population at risk is not known, although in some cases it was known that they had lived for one or two years after operation.

It is therefore necessary to deal with a mixed population all of whom have been subjected to the risk of dying from the effects of operation, but whose fate is sometimes unknown or is known only for a shorter period than that required for estimating the survival-rate correctly.

It is possible to make some allowance, although not a satisfactory allowance, for the defects of the material, by means of the method of the survivorship table. (See Table 8.) In this table the number of survivors is shown based upon all the data obtainable from the literature, regardless of the country in which the operation was performed.

These data were compiled from various sources, concerning the fate of 2,543 persons submitted to radical operation.* Of this number details respecting the first five years from operation are shown in the table. Thus 759 died within the first year (called year 0) either directly after operation or, at any rate, before the first anniversary of the operation; 373 patients were either lost sight of within this year (*i.e.*, it is not known whether they were alive or dead) or were living but had not survived so long as a year

* A series of 116 cases of combined operation (which includes the 42 considered in this report) has recently been published by Miles, too late for inclusion in this report.

at the time the record was made. Similarly 301 patients died more than a year but less than two years after operation, 187 were lost sight of in the second year or were reported upon more than one year but less than two years from operation, and so on for the other entries. What then is the probability that a patient will survive one, two or more years from operation?

If we say that the probability of dying within one year is $759/2,543$ we tacitly assume that none of those lost sight of die within the first year and that those operated upon less than a year ago will certainly live to the end of the year. This is too optimistic an assumption (this is used for column A of Table 8).

If, alternatively, we assume that all those lost sight of are actually dead, and that all those operated upon within the year will die before its end, our numerator becomes $759 + 373 = 1,132$ and the fraction measuring the probability of dying $1,132/2,543$ (Column C of Table 8). This is too pessimistic a use of the material. The "real" death rate must in fact be between 0·2984 and 0·4451.

A middle course is to assume that the floating 373 persons not really under observation a whole year (or until death) were under observation half of the year and so to modify not the numerator but the denominator by subtracting from the latter half of 373, *viz.* 186·5 and stating the probability of dying as $759/2,543 - 186\cdot5 = 759/2,356\cdot5$. This really amounts to saying that the floating population did have a chance of contributing to the recorded deaths for the first six months of the year after operation (it is method B of Table 8), and has an analogy with the method adopted by actuaries in treating lapses of policies when constructing real life tables. At the end of the first year the balance retained is to be subtracted and the floating population of the second year similarly dealt with. This method B has generally been employed in computing Survivorship Tables, but tables of data to which any other desired method can be applied, are given in the appendices. It should also be remarked that, although this survivorship method is extremely useful in giving a rapid summary of the main facts, its apparent precision should not allow the reader to forget the necessarily conjectural nature of its basis. In important cases the "Error of Sampling" by Greenwood's method has been computed. He is of opinion that this is a minimum measure of the uncertainty attaching to the proportions dependant upon the size of the samples; it does not measure the degree of uncertainty dependant upon material errors of record or a hypothetical treatment of the data for floating population.

TABLE 8A.

Method of calculating survivorship table from data in the literature, showing the average results of radical operation (before 1890 included).

Total number of patients, 2,543.

Year.	Dead during	Living & lost during	Alive beginning			Probability of dying		
			A	B	C	A	B	C
0	759	373	2543	2356·5	2543	759 = ·2984	759 = ·3220	1132 = ·4451
1	301	187	1411	1317·5	1411	301 = ·2133	301 = ·2284	488 = ·3458
2	175	111	923	867·5	923	175 = ·1895	175 = ·2017	286 = ·3098
3	87	164	637	555	637	87 = ·1365	87 = ·1567	251 = ·3940
4	57	38	386	367	386	57 = ·1476	57 = ·1553	95 = ·2461
						386	367	386

Hence the corresponding "probability of surviving" year by year is as follows :—

TABLE 8B.

Year.	Probability of surviving		
	A	B	C
0	1—0·2984	1—0·3220	1—0·4451
1	1—0·2133	1—0·2284	1—0·3458
2	1—0·1895	1—0·2017	1—0·3098
3	1—0·1365	1—0·1567	1—0·3940
4	1—0·1476	1—0·1553	1—0·2461

From which may be derived the following table :—

TABLE 8C.

Expected number of survivors 1, 2, 3, 4, 5 years respectively after radical operation.

Years after operation.	A	B	C
0	1000	1000	1000
1	702 ± 9·1	678 ± 9·6	555 ± 9·9
2	552 ± 10·5	523 ± 10·8	363 ± 9·5
3	447 ± 11·1	418 ± 11·2	251 ± 8·6
4	386 ± 11·3	352 ± 11·4	152 ± 7·1
5	329 ± 11·9	297 ± 11·7	114 ± 6·3

The graphical representation of these results is given in Fig. 1, Appendix II.

The final calculation in Table 8C shows that on the most favourable calculation 44·7 per cent. of all patients submitted to operation are alive at the end of 3 years. Under calculation by Method B, which is probably more accurate, but somewhat too unfavourable, 41·8 per cent. were alive. These figures correspond reasonably well with the results obtained below by a simpler though probably less accurate method in the results for all countries taken together.

(b) *Results at three years by countries.*—For the purpose of this estimation it was decided to reject all patients who had been operated upon before the year 1890 and to calculate the percentage of survivals at 3 years after operation, after deducting all cases not traced or dying of causes other than cancer and making special calculations as above in respect of those patients who, although alive, had not as yet had the chance of surviving as long as 3 years since operation. The total number of deaths includes (1) all deaths from operation in the whole series ; (2) all deaths among those who had been exposed to risk for not less than 3 years since operation and who died under the 3 complete years as well as (3) deaths among those who had not been exposed to risk for the complete period. Hence we have a population alive under 3 years from operation whose ranks have already been thinned fully by operative deaths and partly by deaths from cancer since operation. In the absence of exact data we are not justified in assuming that none of those still alive under 3 years will die before the 3 years have elapsed. The most favourable method—method A—is based on this supposition. The results thus obtained will almost certainly be too favourable. Equally, as the severest toll has already been taken (because the mortality is greatest in the first year after operation, see Appendix II, Table 32), it is probably showing a too favourable result to assume that as many as 50 per cent. of the survivors will die before the remaining months of the full 3 years have elapsed. The supposition that all of them will die is unreasonably unfavourable (compare method C in Table 8A) and is not borne out by any general consideration of cancer statistics. This last method, therefore, is not shown in the following table.

TABLE 9.
Results of Radical Operations at 3 years (from 1890 onwards).

Country.	No. of Authors.	Died under 3 years.			Alive under 3 years.	Net Entrants.	Alive at 3 years.		
		Total No. of Cases.	Of Operation.	Of Other Causes.			No.	Percentage.	No.
England ...	7	481	46	9	109	23	126	449	294
France ...	5	96	16	2	10	29	18	65	39
United States ...	5	212	46	2	34	32	47	178	98
Germany ...	5	497	110	5	179	20	54	472	183
Austria ...	5	909	126	11	288	126	117	772	358
Other Countries ...	4	149	26	4	64	4	26	141	51
TOTALS ...	31	2,344	370	33	684	234	388	2,077	1023

The number of "net entrants" has been obtained by deducting the cases "lost" and those "died of other causes" from the original total.

The number of survivors in column A. has been calculated on the assumption that none of those "alive under 3 years" died of cancer within 3 years of operation, whilst column B. is calculated on the assumption that half of those cases "alive under 3 years" died of cancer within 3 years of operation.

The figures for Belgium, Switzerland and Czechoslovakia being small have been grouped together under the heading "Other Countries,"

There is some variation in the percentage alive at three years for the different countries, but this variation is not so great as to destroy the value of the mean figure for the whole series, *viz.*, 39·9 per cent. by method B. If the two smallest series, those for France and for "Other Countries," be excluded from the calculation the result is very little altered, the new figure obtained by method B being 40·7 per cent. (*cf.* Table 8c). As already noted this figure corresponds closely with that obtained by the survivorship method.

(c) *In relation to the type of operation.*—Considering now the fate of the patients according to the type of radical operation which they underwent, it is found that the figures for the perineal and sacral operations are large enough to enable the two sexes to be considered separately but that in the case of the combined operation this is not so.

That the samples submitted to the three different types of operation are comparable as regards age and sex distribution is shewn in Table 33, Appendix III, where will also be found the figures from which Tables 10 11, and 12 were calculated. The samples are also comparable as regards the position of the growth (*i.e.* high, middle or low). It is true that the proportion of high growths is greater for the sacral operation than for the perineal, but this difference is believed to be insufficient to affect the comparability of the figures.

The figures in brackets in the tables are the probable errors.

TABLE 10.

Expected numbers of survivors after Perineal Operation.

Years after Operation.	Survivors (Method B.)			
	Males (361 cases).	Females (241 cases).	Both Sexes.	
			All data (602 cases).	Data after 1890 (467 cases).
0	1000	1000	1000	1000
1	617 ($\pm 26\cdot8$)	754 ($\pm 29\cdot2$)	672	687
2	477 ($\pm 29\cdot6$)	608 ($\pm 35\cdot2$)	530	531
3	386 ($\pm 30\cdot8$)	558 ($\pm 37\cdot0$)	456	488
4	339 ($\pm 31\cdot1$)	447 ($\pm 40\cdot4$)	383	406
5	305 ($\pm 31\cdot6$)	426 ($\pm 41\cdot2$)	354	?
6	279 ($\pm 32\cdot2$)	400 ($\pm 42\cdot5$)	328	?

TABLE 11.

Expected numbers of survivors after Sacral Operation.

Years after Operation.	Survivors (Method B.)		
	Males (430 cases).	Females (265 cases).	Both Sexes (695 cases).
0	1000	1000	1000
1	706 (± 22.8)	710 (± 28.7)	702
2	501 (± 26.4)	578 (± 32.7)	520
3	382 (± 17.1)	423 (± 35.8)	390
4	330 (± 27.5)	369 (± 37.3)	339
5	271 (± 28.2)	332 (± 39.3)	287
6	236 (± 28.7)	(332)	263
7	218 (± 29.2)	312	?

TABLE 12.

*Expected numbers of survivors after Combined Operation.
(Both sexes included.)*

Years after Operation.	Survivors B. (229 cases).
0	1000
1	529 (± 35.3)
2	478 (± 37.6)
3	453 (± 38.2)
4	403 (± 40.1)
5	(403)
6	365

The following deductions may be made from a study of these tables :—

(1) The results (for both sexes together) of the combined operation appear to be worse than those of the other two types up to the end of the second year after operation. At about this period they begin to improve and at the end of the third year they are nearly the same as those of the perineal operation and better than those of the sacral. The figures for the combined operation are, however, very small and the above deductions must therefore be regarded as merely tentative.

(2) The results (for both sexes together) of the perineal and sacral operations are practically the same up to the end of the second year, but after that the perineal has an advantage over the sacral operation.

(3) For males the results of the perineal and sacral operations are very nearly the same, but females do much better after the perineal operation than after the sacral.

For certain cases it has been possible to shew the effect of removal or not of bone in relation to survival. The number of such cases is not large but the results appeared to be of sufficient interest and importance to place in an appendix (*cf.* Appendix IX). If allowance be made for the probable error it is seen that in the sample available there is some advantage in favour of the cases in which no bone has been removed.

(d) *In relation to Sex.*—Table 13 shews the results of all types of radical operation for the two sexes considered separately, in the form of a survivorship table. The data from which this table is constructed are given in Table 37, Appendix VI.

TABLE 13.
Survivors after all types of operation.

Years after Operation.	Males (847 cases).	Females (505 cases).
0	1000	1000
1	626 ($\pm 17\cdot 2$)	627 ($\pm 21\cdot 7$)
2	435 ($\pm 18\cdot 6$)	521 ($\pm 24\cdot 2$)
3	319 ($\pm 18\cdot 6$)	424 ($\pm 25\cdot 1$)
4	270 ($\pm 18\cdot 5$)	340 ($\pm 25\cdot 8$)
5	229 ($\pm 18\cdot 5$)	301 ($\pm 27\cdot 4$)
6	189 ($\pm 18\cdot 4$)	295 ($\pm 27\cdot 5$)

The following conclusions may be drawn from the above table and from Tables 10, 11, and 12 :—

(1) The prospects of survival are better for females than for males at all periods after radical operation.

(2) Females do better than males after the perineal operation. The same is true for the sacral operation but to a lesser degree.

(e) *In relation to the Stage of the Disease.*—With regard to the results of the perineal operation the experience of Lockhart Mummery already referred to (*v. p. 13*) is of interest. In his report on two hundred cases of cancer of the rectum treated by perineal excision he estimates his cures by this method on a three year basis to be 55·5 per cent., or on a five year basis 54·8 per cent. The figures are much higher than those for the whole literature, but it is not for this reason that they are referred to here but rather because the surgeon gives us information as to the relation of the stage of the disease at operation to the probability of the patient's survival.

He divides his cases into three classes, as already explained on p. 13 and Table 14 shews the percentage of cases in each class which survived more than five years, leaving out of account untraced cases and deaths from other causes.

TABLE 14.
Results of Perineal Operation at 5 years (Mummery).

Class of Cases.	Total No. in this Class.	Cures, 5 years basis.	Recurrences.	Percentage Cure.
A.	30	22	8	73·7
B.	43	19	24	44·1
C.	9	4	5	44·4

This table brings out clearly the greatly improved prospects of cure possessed by patients who underwent the perineal operation for cancer of the rectum at the hands of this surgeon when the disease was operated upon at an early stage. The number of cases in Class C is too small to admit of definite deductions as to prognosis but the author concludes that "such cases are well worth operating upon."

(f) *In relation to the Position of the Growth, its Fixity or Mobility and the Age of the Patient.*—An attempt was made to estimate the influence of each of these three factors upon the survival of the patient, but in each case the data available proved insufficient to allow of any definite deductions. The figures are however, set forth for the sake of completeness in Appendices VII, VIII and V respectively.

(g) *Gain from Operation.*—Greenwood in his report on the Natural Duration of Cancer* has provided a standard of comparison by means of which average results of one kind of treatment may be compared with those of another kind. This standard has been arrived at by consideration of evidence relating to a large number of cases (887 cases of *rectal* cancer) in which only palliative treatment had been given. The duration of the disease in these cases has been estimated from information given by the patients and the results have been utilised in the construction of a survivorship table by the method explained at the beginning of this section (v. p. 16). The table so obtained is shown below in column 2 of Table 15. It shews the probable fate, on the average, of 1,000 patients suffering from cancer of the rectum who receive no treatment.

Suitably modified, as indicated below, this table may be used to measure the effect of radical operation on rates of mortality from year to year.

* Reports on Public Health and Medical Subjects No. 33. Ministry of Health. 1926.

In Table 28, p. 38, the average alleged duration of symptoms at the date of radical operation for 1,189 cases (up to the end of the third year) is shewn to be approximately one year, although the greater number of cases undergo operation before that period has elapsed. In the survivorship tables survivors are shewn year by year from the date of operation. If, therefore, we are to determine the advantage, on the average, of radical operation, we should allow for the exposure to risk of death from cancer during a period which is, on the average, approximately one year. This is so because every patient may be regarded in this report as starting at year 1 in Greenwood's table, *i.e.* the patient is one of the 760 in Table 15, Column 2. Hence, if Greenwood's table is so modified as to convert the 760 into 1,000 and increase the other figures in the same ratio of $\frac{1000}{760}$ we shall have a readier means of comparison with tables in the present report.

The table so modified is shewn in column 3 of Table 15. The remaining columns of Table 15 give the results of the different types of radical operation in terms of survivorship and by comparing these figures with those of column 3 an estimate may be formed of the gain from the various operations at any period up to five (or in the case of the sacral operation, six) years from the onset of symptoms.

TABLE 15.

Gain from operations of different types at yearly intervals from the estimated onset of symptoms (both sexes together).

(1) Year.	(2) Natural Duration (Greenwood).	(3) Natural Duration modified.	(4) Perineal operations (1890 on- wards). (467 cases).	(5) Sacral operations (695 cases).	(6) Combined operations. (229 cases).
0	1,000	1,315			
1	760 (± 14.4)	1,000	1,000	1,000	1,000
2	434 (± 16.6)	571	687	702	529
3	213 (± 13.8)	280	531	520	478
4	114 (± 10.7)	150	488	390	453
5	54 (± 7.6)	71	406	339	403
6	30 (± 5.8)	39	?	287	?

It is clear from this table that there is an important gain to the patient from radical operation of any of the three types, the only exception being the result of the combined operation for year 2, in which the effect of the combined operation appears to be worse than that of the untreated disease. This indicates that, partly as a result of the operative mortality, the prolongation of life is only appreciable among those patients who survive more than one year after operation.

It is important at this point to form some estimate of the advantage gained by radical operations of all types taken together.

In the same way as is done on p. 16 for Table 8 (B method) the average number of years lived per person up to the end of the fifth year may be calculated from the modified form of Greenwood's "Natural Duration" table on p. 24 (Table 15) up to the end of the fifth year from the beginning of year 1. The figure obtained is 1·5915, or the 1,000 persons live altogether 1,591·5 years, on the average, up to the end of the fifth year. The patients operated upon show a figure of 2,537·5, i.e. there is a gain for these patients of 946 years or 0·9 per patient, which is an advantage of more than 59 per cent. over the untreated. Though only approximately true, this figure is sufficiently so to prove that as a whole patients selected for radical operation for cancer of the rectum may expect a definite prolongation of life as a direct result of such operation.

These figures are manifestly less favourable than the reality because we are leaving out of account altogether the number of years still to be lived by those who survive. If those patients submitted to operation who have already lived five years be added and if it be assumed that each lives only another three years—which is a modest assumption—roughly another three years of life will be added to each of the hypothetical 1,000 cases. Mummery's data show that after the first three years the number of patients who die of cancer is not great and that many are alive ten years after operation.

2. Recurrences and Metastases.

It is the usual practice in the literature for the author to note the appearance of local recurrences of the cancer. The records regarding metastatic deposits in parts of the body remote from the primary site of the growth are, however, imperfect and probably unreliable because the facts are not easily determinable by the surgeon either as to the presence of deposits or as to the date of their appearance if before or after the operation.

The period after operation at which recurrences appear or at which the patient dies from either a local or regional recurrence or from a metastatic deposit in other viscera is of interest, more especially if it is possible to form an idea of the proportion of these which occur in each year after operation. It is unfortunate that the number of instances in which the data are given with accuracy is so small in the present case as to render them unsuitable for statistical purposes.

Recurrence is a local phenomenon, but it is not generally clear what is the precise site of the recurrent growth, i.e. it is not usually stated if the site is :

- (1) the operation scar ; or
- (2) the gut ; or
- (3) the tissue surrounding the gut ; or
- (4) the local glands.

In the figures used below local recurrences may include all these cases.

Where metastases are stated to have been present as well as a local recurrence the case is regarded as one local of recurrence only and the metastases are ignored for the present purpose.

For a total number of 2,056 cases of radical operation 865 or 41·6 per cent. are accounted for in the group "recurrences and metastases" either living or dead. But as has been already mentioned, the presence of metastases is difficult to determine and the figures are therefore not reliable.

Zinner found that 72 per cent. of his combined group of recurrences and metastases were accounted for by local recurrences, while 4 per cent. involved local glands and 24 per cent. occurred in internal organs.

Table 16 gives the experiences of Mandl and of Russell with regard to the frequency of metastases at various sites.

TABLE 16.

Position of Metastases.	Frequency.
Retroperitoneal Glands ...	42
Liver	38
Local Perirectal	32
Bladder	13
Lungs	12
Vagina	7
Peritoneum	5
Ovary	5
Pleura	3
Uterus	2
Small Intestine	2
Large Intestine	
Abdominal Walls	
Ureter	
Mesentery	
Skin	
Bones	
	Once each

In many of the cases quoted by these authors metastases were found at more than one site.

Pennington (U.S.A.) collected the particulars relating to 997 postmortem examinations on patients who had suffered from cancer of the rectum. In approximately one third of these (324 cases) "the regional nodes" were affected and at points "beyond the reach, as a rule, of the perineal or Kraske operation."

3. Functional Results.

From the patient's point of view the question of faecal continence after operation is of great importance.

The subject is not, however, dealt with consistently by authors; many make no allusion to it and few supply full information.

There are degrees of continence and probably every surgeon has his own classification. Continence may improve as time elapses after the operation, for patients who are incontinent immediately after operation may acquire a certain control, either actual muscular control or a consciousness of what is required. A rough classification is possible into :—

1. Incontinence,
2. Continence,
3. Partial or Relative Continence.

One type of case which offers difficulty in classification is that in which the patient is really unable to hold faecal matter but feels the necessity for emptying the bowel. It may be grouped in the third category. The latter includes cases of incontinence for liquid and gas with continence for solids.

When an artificial anus is created in the abdominal wall the patient usually wears an apparatus and the literature mentions patients who go about their daily duties, sometimes strenuous in character, without much inconvenience. Such patients usually acquire a suitable routine. On the other hand, the abdominal anus is sometimes an insupportable infirmity to the patient and cases of suicide are recorded.

In cases of amputation of the lower end of the rectum the artificial anus, whether perineal, coccygeal or sacral in position, gives variable results. In these cases partial continence may be acquired.

A sacral anus is frequently fashioned by Austrian surgeons, chiefly Hochegger and his associates, but is not popular in other countries. Hochegger defends it and claims to control it by means of appliances and dieting.

The different procedures employed for dealing with the divided rectum after radical operation are considered later under "Resections and Amputations." It is useful, however, at this point to refer to certain data in which these various methods are distinguished when recording the functional results of operation.

The following table refers to cases of amputation :—

TABLE 17.

Country.	Total No. of patients	Reported as			Others.
		Continent.	Incontinent.	Partially continent.	
Switzerland ...	60	6	9	15	30
Germany ...	338	11	38	61	228
Total ...	398	17	47	76	258

The column "Others" comprises 59 patients who died at operation and those others about whom information is lacking. Of the remainder it is seen that relatively few are continent (12·1 per cent.), whilst 54·3 per cent. are partially continent and 33·5 incontinent.

A similar table referring to cases of resection follows :—

TABLE 18.

Country.	Total No. of patients.	Reported as			Others.
		Continent.	Incontinent.	Partially continent.	
Switzerland ...	33	7	6	4	16
Germany ...	385	92	21	33	239
Austria ...	207	79	8	29	91
Totals ...	625	178	35	66	346

Of the 346 under "Others," 143 died at operation. The number of "continent" patients is in greater proportion (63·7 per cent.) than in the cases of amputation first considered.

In regard to functional results Mandl publishes some interesting facts. He found that after deduction of deaths 19·3 per cent. of cases of primary circular suture were discharged as continent. By lapse of time the condition of patients improved so that his results for circular suture (*v. p. 33*) became :—

49·4 per cent. fully continent

19·1 relatively continent

31·5 per cent. incontinent

Similarly for the "pull through" method (*v. p. 33*) 58·3 per cent. were discharged as fully continent. The end results in this group were :

64·5 per cent. fully continent

16·6 per cent. relatively continent

18·6 per cent. incontinent.

Other results are :—

TABLE 19.

Author.	No. of cases of circular suture.	No. of cases of "pull through" method.	Primary healing or full continence on discharge from Hospital.
Schede ...	14		2 cases.
Kraske... ...	39		16 ,,
Poppert ...	20		10 ,,
Goldschmid ...	{ 73	21	21·9 per cent. 38 ,,

Zinner found that 37·9 per cent. of cases of circular suture and 62·5 per cent. of the cases of "pull through" respectively became fully continent.

Kupferle's figures are :—

TABLE 20.

	Continent.	Relatively Continent.	Incontinent.
Circular suture	...	8	10
Amputation :—			2
Perineal anus	...	—	20
Sacral anus	...	—	2
			14
			14

Resection appears to give the best functional results and the "pull-through" method to be the most effective method of securing faecal continence. The method has many limitations, e.g. in Mandl's series it was employed only 48 times out of a total of 187 resections.

VI. COLOSTOMY.

In connection with cancer of the rectum the chief uses of colostomy are :—

- (1) as a palliative measure,
- (2) as a preliminary to radical operation,
- (3) as a permanent measure and part of the radical operation involving amputation of the rectum.

Before considering in turn these three main uses of colostomy it will be as well to deal with two considerations of a general nature.

Causes of Operative Deaths.

Gant states that the most frequent causes of death following colostomy in his experience are pneumonia, nephritis, peritonitis from partial or complete retraction of the gut end or perforation from an ulcer, shock, suppression of urine or lastly an acute exacerbation of other pre-existing chronic disease.

Eichhoff reporting on a series of 166 cases of colostomy with 24 operative deaths states that the most frequent causes of death were peritonitis, heart failure and collapse, and lung affections, the frequency being in the order named.

Influence of Obstruction.

With regard to the relation of the condition of the patient at operation to the operative mortality Cripps' figures are of interest. He states that out of 20 patients operated upon after complete obstruction had occurred 11 died, giving an operative mortality of

55 per cent., whereas of 123 patients operated upon *before* complete obstruction had supervened, only 5 died, giving an operative mortality of 4·6 per cent. Complete obstruction had been present in the fatal cases for an average period of 11 days. This experience corresponds with that of Mandl, who reports an operative mortality of 44 per cent. for 34 colostomies in the presence of obstruction, whereas with 150 other cases the mortality within 10 weeks was only 12·1 per cent.

The three chief uses of colostomy will now be considered.

1. Palliative.

As a method of palliation colostomy is regarded as of the greatest value. The left iliac form of operation is the one generally favoured at the present day. The indications and advantages of colostomy are amply discussed in the literature but the statistical data provided are scanty.

(a) *Operative Mortality*.—Table 21 gives the figures of various authors shewing the immediate mortality amongst patients on whom colostomy was performed as a palliative measure.

TABLE 21.
Immediate Mortality from Colostomy.

Author or Hospital.	Date.	Colostomy.			Died.	Immediate Mortality.
		Inguinal	Lumbar.	Type not stated.		
Hartmann ...				91	6	6·6
Bryant ...	1859–1884		60		26	43·3
Cripps ...	1885–1905			143	16	11·18
St. Bartholomew's Hospital (Cripps)	{ 1869–1879 1879–1889 1889–1905		46 48 364		32 22 95	76·1 45·9 20·6
Middlesex Hospital (Colwell & Woodman)	{ 1854–1903 1904–1908	{ 90 38	75 4		13 14 2 4	17·3 15·5 50·0 10·5
Batt ...	1884			154	48	31·1
Viuchoud ...	1887–1910			60	?	19·3
Bull ...	1919			14	4	28·6
Borelius ...				77	16	20·0
Gant ...				?	?	2
Eichhoff ...	1879–1920			166	24	14·4
Totals ...	...	...	492	233	705	322
					1,430	22·5

(b) *Duration of life following Palliative Colostomy.*—The information available with regard to the duration of life following palliative colostomy is scanty. The following summary gives the experience of various authors in this connection.

Author.	Type of Colostomy.	No. of Cases.	Duration of Life after Colostomy.
Jessop	Lumbar ...	34	13 months.
Colwell and Woodman	Inguinal ...	28	15·4 ,,
	Lumbar ...	16	8·8 ,,
Hartmann	Iliac... ...	91	12 ,,

(c) *Prolongation of life due to Palliative Colostomy.*—It is important at this point to try to form an estimate of the effect, if any, of palliative colostomy in prolonging life.

Wyard concluded from an analysis of the records of the Cancer Hospital, London, for the years 1900–1924, that there was no support for the general impression that colostomy prolongs life. He found that in a series of 450 cases of which 319 were submitted to colostomy, the average duration of life (for each sex) was exactly the same, whether the patients were colostomised or not, viz. 28 months from the date (or estimated date) of onset of symptoms for males and 29 months for females.

Cripps found that the average length of life after colostomy was 22 months in 97 cases. Further data are offered by Gant and by Eichhoff, but it is doubtful how far the conditions are comparable.

It may be noted that Jessop found the average duration of life after operation in 34 lumbar colostomies performed by him to be 53 weeks, whereas for 37 inoperable patients who refused colostomy the average duration of life was 34 weeks.

2. Preliminary to Radical Operation.

Examination of the literature reveals great differences of opinion as to the value of colostomy as a preliminary to radical operation.

The advantages of the procedure were set forth by Millard (Geneva, 1897) as follows :—

- (a) It permits of the disinfection of the lower extremity of the intestine.
- (b) After operation the rectal wound is sheltered from faecal matter.
- (c) The colostomy permits of feeding the patient up to the time of operation.
- (d) The rectum is put in repose and a great cause of recurrence removed.
- (e) The iliac anus is better than the sacral anus because it is more accessible.
- (f) If local recurrence in the rectum occurs the patient with an iliac anus is better off than if he had been without it.

The principal objections to preliminary colostomy which have been proffered are as follows :—

- (a) The patient, who is probably rather weak already, is further weakened by the colostomy before being submitted to the severe trial of a radical operation.
- (b) Additional and dangerous delay is occasioned by this preliminary procedure.
- (c) There is a real risk of peritoneal infection following the colostomy.
- (d) Later repair of the artificial anus is sometimes difficult.
- (e) Technical difficulties in dealing with the anchored bowel are encountered at the radical operation.

The evidence contained in the literature is quite insufficient to permit of adjudication upon these two conflicting views, both of which have been and are held by surgeons of skill and experience. The following table, giving the experience of Mayo, is however of interest.

TABLE 22.

Abdominal or Combined in one or two Stages.

	No. of Cases.	Discharged.	Died.	Mortality.
Abdominal and abdo-perineal single stage 	14	9	5	35
Preliminary Colostomy with Secondary posterior opera- tion, 2 stages 	30	26	4	13
Totals ...	44	35	9	20

3. Permanent (part of a Radical Operation).

Permanent colostomy seems to be popular in England ; both Miles and Mummery adopt it as a routine. In France "l'opération de Quénu," as the abdomino-perineal operation with a permanent left iliac anus is designated, has a wide vogue. In Austria, however, the sacral anus is more common because of the frequent use of the Kraske operation. For Germany the same remark holds. Mummery's series represents cases in which permanent colostomy was employed.

Though there are very few figures dealing with the state of health of patients with permanent colostomy the statement often appears that patients with such a colostomy are not necessarily debarred from following their usual occupations. Mummery quotes a fair number of such cases.

The impression gained is that some surgeons avoid the artificial abdominal anus at all costs, others consider it better for the patient than the sacral anus, whilst others again maintain that the complete clearing out of the pelvis and the formation of a new anus confer greater security against recurrence.

VII. RESECTIONS AND AMPUTATIONS.

The relative merits of resection and amputation of the rectum are discussed in the literature. Here the subject is dealt with irrespective of the type of operation with which these procedures are associated.

By the term resection of the rectum is understood the procedure in which the rectum is cut across completely at two situations above and below the growth, and the gap in the gut repaired either—

- (1) by complete or partial circular suture of the two free ends together
- or (2) by pulling down the lower end of the upper portion of gut to the anal margin.

The circular suture may be carried out either after simply approximating the free ends *in situ* or after the free ends have been pulled down through the anal orifice, the so-called Invagination method.

Suturing of the upper gut to the anal margin is accomplished by pulling it through the anal canal (Durchzug-methode). The anal canal may or may not be denuded of its mucous membrane before the suture is inserted.

The term amputation usually signifies that the lower portion of the rectum or anal canal is removed together with the anus and anal sphincter.

Either resection or amputation may be employed whatever the mode of approach to the rectum selected by the surgeon. The former procedure is general with operations of the sacral type, for the preservation of the sphincteric apparatus is then one of the principal aims. Sacral amputations of the rectum are also quite numerous. In such operations the usual procedure is to create a sacral anus. Amputation is general with operations of the perineal and combined types. It necessitates the formation of an artificial anus. It is difficult in many cases recorded to decide whether to designate a procedure as amputation when it is not clearly stated whether the whole or a portion only of the sphincter was removed. Similarly in cases of "excision" or "extirpation," so called by the author, it may be doubtful whether one case is classifiable as resection or another as amputation.

Mandl quotes some relative frequencies of the chief methods of repairing the gut after resection.

TABLE 23.

Author.	Circular Suture.	Invagination.	"Pull through" (Durchzug-methode).	Total.
Zinner	30 complete 2 partial	7	31	70
Goldschmid ...	73	4	21	98
Rotter	35	2	26	63
Korbl		1	27	28
Mandl	119 complete 10 partial	10	48	187
Total ...	269 (60.3%)	24 (5.4%)	153 (34.3%)	446

In compiling the following table an endeavour has been made to include only clear cases of resection or amputation.

The total numbers of resections and amputations, irrespective of the method of operation, collected from various countries are 682 and 622 respectively. Survivorship tables calculated according to B method, Table 8, are given in the following table. (For data *v.* Appendix IV.)

TABLE 24.

*Expected number of Survivors 1, 2, 3, 4, or 5 years
after Operation*

Years after operation.	Resections (682 cases).	Amputations (622 cases).
0	1,000	1,000
1	652	624
2	484	441
3	366	335
4	282	279
5	251	250
6	220	232

It does not appear from these tables that there is much difference, on the average, between the yearly rates of mortality for resections and amputations. On the other hand the operative mortalities are respectively 23.8 per cent. and 14.5 per cent.

VIII. FREQUENCY OF COMMON SYMPTOMS.

1. The First Indication of the Disease.

(a) *General.*—Table 25 has been constructed from data given by Colwell and Woodman and by Mandl in relation to 1,244 cases of cancer of the rectum in which information as to the first indication of rectal abnormality was obtainable from the patient.

TABLE 25.
First Indication of the Disease.

Symptom or Condition.	Number of cases.	Percentage.
Irregularity of Stool*	410	33·0
Pain (in rectum, back or abdomen)†	356	28·6
Blood in motions	285	22·9
Tenesmus	96	7·7
Discharge from rectum	41	3·3
Emaciation	30	2·4
Pain on Micturition...	9	0·7
Feeling of Tumour in Rectum	9	0·7
Diminution in size of Motions	7	0·6
Incontinence of Faeces	1	0·1
Totals	1,244	100·0

It will be seen from Table 25 that though no one symptom can be regarded as the first indication of cancer of the rectum in a majority of cases, irregularity of stools, pain and blood in the motions are far commoner than any of the other symptoms and conditions recorded.

(b) *In relation to the Site of the Growth.*—It seemed of interest to ascertain if possible whether the nature of the first symptom or sign of the disease bore any relation to the distance of the growth from the anal margin. Table 26 gives the relevant particulars of 398 cases for which such information is given.

* The details of these irregularities are not available for the whole series, but of 223 cases in Colwell and Woodman's series constipation was the first symptom in 100 cases and diarrhoea in 87.

† In 274 of these 356 cases the pain is stated to have been "in the rectum."

TABLE 26.

Position of Growth in relation to First indication of Disease.

First alleged symptom or condition.	Total number of cases.	Position of lower edge of growth.*			
		Low.	Middle.	High.	Not stated.
Blood at Stool ...	75	25	42	4	4
Constipation ...	60	15	37	6	2
Pain (anus, rectum, perineum, sacrum or abdomen) ...	58	16	30	7	5
Pain at Stool ...	49	22	20	2	5
Tenesmus ...	16				
Tenesmus and Blood at Stool ...	33	10	15	3	5
Piles ...	33	11	19	—	3
Diarrhoea ...	28	5	17	4	2
Blood and Pain at Stool ...	21	11	7	3	—
Tumour at Anus ...	11	6	3	—	2
Alternate Constipation and Diarrhoea ...	10	—	9	1	—
Diarrhoea and Blood at Stool ...	9	3	6	—	—
Prolapse ...	6	4	2	—	—
Diarrhoea and Pain at Stool ...	5	—	2	3	—
Totals ...		398	128 (32%)	209 (53%)	33 (8%)
					28 (7%)

It will be seen from this table that blood at stool was noticed in 122 cases altogether. If the 17 cases which had tenesmus as well, the distribution of which at different sites is not given, be excluded, this leaves 105 cases of which 39 (37 per cent.) were those with low growths, 55 (52 per cent.) with middle growths, and 7 (6 per cent.) with high growths, the position of the growth not being stated in the other 4 cases.

Pain at stool was noticed in 75 cases altogether, of which 33 (44 per cent.) were those with low growths, 29 (38 per cent.) were those with middle growths and 8 (11 per cent.) were those with high growths, the position of the growth not being stated in the remaining 5 cases.

Diarrhoea (apart from that alternating with constipation) was noticed in 42 cases altogether, of which 8 (19 per cent.) were those with low growths, 25 (59 per cent.) were those with middle growths, and 7 (17 per cent.) those with high growths, the position of the growth in the remaining 2 cases not being stated. The distribution

* The classification of growths employed here is that explained on p. 3.

of the 60 cases with constipation is 15 (25 per cent.) with low growths, 37 (61 per cent.) with middle growths and 6 (10 per cent.) with high growths, the position of the growth not being stated in 2 cases.

The figures for high growths are too small to allow of any deductions, but for low and middle growths blood at stool is the commonest symptom according to the experiences set forth in this table.

The distribution, according to the site of the growth, of the cases with blood at stool and of those with constipation or with diarrhoea, is roughly similar to that of the total cases, but with cases in which pain at stool was the first indication of the disease, the distribution is markedly different, the highest percentage of cases with this symptom being those with low growths. In fact, it may probably be stated that if pain at stool is the first indication of the disease the growth is most likely to be a low one.

2. Later Indications of the Disease.

The relative frequency of certain signs and symptoms later in the disease is shown in Table 27, for 3,828 cases.

TABLE 27.

Later Indications of the Disease.

Signs and Symptoms.	Number of cases.	Percentage of total.
Irregularity of Stool	843	22·0
Blood in Motions	823	21·4
Pain (rectum, back or abdomen)	807	21·1
Wasting	474	12·4
Tenesmus	332	8·7
Discharge from Bowel	263	6·9
Change in form of Stool	135	3·5
Urinary Troubles	73	1·9
Incontinence of Faeces	37	1·0
Feeling of Tumour in Rectum	33	0·9
Ischio-rectal Abscess	6	0·1
Fistula in Ano	2	0·1
 Totals	3,828	100·0

The three most common signs and symptoms, viz., irregularity of stool, blood in motions and pain, are the same as for the early cases, and account for 64·5 per cent. of the total number of later cases here considered.

IX. ALLEGED DURATION OF SYMPTOMS.

1. General.

Table 28 shows the alleged duration of signs and symptoms of cancer of the rectum in 1,234 cases submitted to operation.

TABLE 28.
Alleged Duration of Disease at date of Operation.

Alleged Duration of disease in months.	Less than 1	1-3	3-6	6-12	12-24	24-36	36-48	48-60
Number of cases	9	96	250	394	317	123	38	7

The mean duration of the disease in these 1,234 cases at the date of operation was 13·1 months. Greenwood, in his "Natural Duration of Cancer," already referred to, gives the mean duration of life for unoperated cancer of the rectum as 26·7 months. If we take only those cases in Table 28 in which the duration of signs and symptoms was less than 3 years, the mean duration of the disease at the time of operation becomes 12 months.

2. In relation to the Age of the Patient.

Tables 29A and 29B show the age distribution of 723 patients grouped according to the alleged duration of the disease at the time of operation, Table 29A giving the actual number of patients in each age group and Table 29B the percentages. The necessary details were not available for the whole of the 1,234 cases shown in Table 28.

TABLE 29A.
Alleged Duration of Disease in relation to Ages of Patients.

Alleged Duration of disease in months.	Patients.	Number of Patients in Age Groups.						
		20-29	30-39	40-49	50-59	60-69	70-79	80-89
0-3 ...	77	4	12	16	28	16	—	1
3-6 ...	156	4	17	37	58	33	7	—
6-9 ...	142	6	16	39	41	39	1	—
9-12 ...	89	1	11	22	34	17	4	—
12-18 ...	156	5	17	30	55	40	9	—
18-24 ...	41	—	6	13	6	14	2	—
24-30 ...	62	2	5	16	16	19	3	1
Totals ...	723	22	84	173	238	178	26	2

TABLE 29B.

Alleged Duration of Disease in months.	No. of Patients	Percentage of Patients in Age Groups.								Total.
		20-29	30-39	40-49	50-59	60-69	70-79	80-89		
0-3	77	5·2	15·6	20·8	36·4	20·8	—	1·2	100·0	
3-6	156	2·6	10·9	23·7	37·2	21·1	4·5	—	100·0	
6-9	142	4·2	11·2	27·5	28·9	27·5	0·7	—	100·0	
9-12	89	1·1	12·4	24·7	38·2	19·1	4·5	—	100·0	
12-18	156	3·2	10·9	19·2	35·3	25·6	5·8	—	100·0	
18-24	41	—	14·6	31·7	14·6	34·2	4·9	—	100·0	
24-36	62	3·2	8·1	25·8	25·8	30·7	4·8	1·6	100·0	
Totals...	723	3·0	11·6	23·9	33·0	24·6	3·6	0·3	100·0	

It is often stated that in young persons cancer of the rectum grows more rapidly and kills the patient sooner than occurs with older patients. If this were true we should expect to find a larger proportion of young persons amongst those operated upon at an early stage of the disease. Table 29B does not, however, support this view, but shows rather that the age distribution of the patients is very much the same at whatever period of the disease they apply for treatment, or in other words, the younger patients do not come to operation more quickly than the older patients.

3. In relation to the Site of the Growth.

The position of the growth (*i.e.* the distance of the lower edge from the anal margin) has not been found to exercise any definite influence upon the period of the disease at which the patients come to operation. The data for the "high" growths are too small to be of any value. The figures are set out in Appendix X.

X. SUMMARY AND CONCLUSION.

Below are set out the main facts that have been elicited by the review of the literature undertaken in this report, together with the conclusions that may be drawn from them. Many other points of minor importance, but of some interest, have been considered in the appropriate sections of the report and these may be found by referring to the table of contents.

1. Operability.

(1) Information as to operability is given in the literature for 5,231 cases. When grouped under the countries of origin the mean

operability varies from 35 per cent. to 67 per cent., with a mean operability for the whole series of 48·5 per cent. (*v. p. 10*).

(2) The data available with regard to the relative operability of the two sexes are very limited, but so far as they go they confirm the general opinion of surgeons that the operability is higher for women than for men (*v. p. 10*).

2. Operative Mortality.

(1) The operative mortality for 5,240 cases of radical operation is shown to be 16·5 per cent.*

(2) When the sexes are considered separately the operative mortality for 860 males is found to be 18·9 per cent., whilst for 538 females it is 15·0 per cent. (*v. p. 12*).

(3) In relation to the type of radical operation performed the operative mortality (both sexes together) is found to be heaviest (32·0 per cent.) in the case of the combined operation and lightest (15·4 per cent.) in the case of the sacral operation the perineal operation being intermediate (17·4 per cent.). When the two sexes are considered separately the above order holds good for males but the lowest operative mortality for females belongs to the perineal rather than the sacral operation (*v. p. 12*).

(4) If the position of the growth be taken into account it is found that the higher the growth the higher the operative mortality (*v. p. 13*).

(5) Data relating the stage of the disease to the operative mortality are given by one surgeon only, but tend, so far as they go, to show that the operative mortality is much higher than the mean for cases in an advanced stage of the disease (*v. p. 13*). This finding is in accordance with that already given for Cancer of the Uterus.

(6) "Sepsis" is found to be much the most important immediate cause of operative deaths, being responsible for nearly half the deaths from operation. "Shock and collapse," the next cause in order of importance, only accounts for a little more than half the deaths due to "sepsis" (*v. p. 14*).

3. Fate of Patients submitted to Radical Operation.

(1) Of 2,344 patients, with regard to whom the necessary information is available, 39·9 per cent. are estimated as having been alive three years after operation. When grouped according to their country of origin the percentage is found to vary from 26·9 to 51·4 per cent. (*v. p. 19*).

(2) When the results are considered in relation to the type of radical operation employed those of the perineal and sacral operations are found to be practically the same up to the end of the second

* A series of 116 cases of combined operation (which includes the 42 considered in this report) has recently been published by Miles, too late for inclusion in this report. The figure for the operative mortality of the total series given above would not be affected by the inclusion of these additional cases.

year, but after that the perineal operation has an advantage over the sacral. Females are found to do much better after the perineal operation than after the sacral (*v. pp. 20, 21*).

The figures for the combined operation are too small to allow of any definite deductions.

(3) Considering the two sexes separately the prospects of survival are found to be better for females than for males at all periods after radical operation (*v. p. 22*).

(4) Analysis of 2,543 cases submitted to radical operation during the past 50 to 60 years shews that the average number of years lived per patient up to the end of five years after operation was 2·53. On the other hand it has been estimated that the corresponding figure for the un-treated patient is 1·59 years, so that on the average radical operation prolongs the life of a patient by 0·9 year (for patients dying within 5 years) or in other words the patient submitting to radical operation but dying within 5 years has an advantage of 59 per cent. over the untreated patient (*v. pp. 23, 24, 25*).

4. Symptomatology.

(1) Much the commonest first indications of cancer of the rectum are irregularity of stool, pain (not at stool) and blood in the motions, in the order named. These three signs and symptoms taken together account for 84·5 per cent. of the 1,244 cases for which this information is given (*v. p. 35*).

(2) Of the later indications of the disease, irregularity of stool, blood in the motions, and pain are found to be the commonest, in the order named, and account for 64·5 per cent. of the 3,828 cases for which this information is given (*v. p. 37*).

The considerations set forth above clearly demonstrate the great importance of carrying out a thorough examination at the first opportunity of all patients, or at any rate of those over 30 years of age, suffering from blood or pain at stool, constipation or diarrhoea, or pain in the anal canal, rectum, perineum, sacrum, or abdomen, in order to detect or exclude the presence of cancer of the rectum. The fact demonstrated above that cancer of the rectum, like cancer at other sites, has no peculiar symptoms or signs, undoubtedly adds to the difficulty of diagnosis, but it does not in any way absolve the patient's medical attendant from the duty of carrying out a thorough examination at the earliest possible moment if any of the chief early indications just enumerated be present.

The statement often made that cancer of the rectum is a painless disease, at any rate in its earlier stages, is in direct opposition to the evidence contained in the literature and this gives us grounds for hoping that the earlier recognition of the disease is not an aim impossible of achievement.

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APPENDIX I.

Data published by certain schools or clinics or by certain surgeons.

In Table 30 are set forth the data given by certain authors with regard to patients upon whom they performed radical operations for the cure of cancer of the rectum. Information regarding operability was not given in a great many cases.

TABLE 30.

Author.	Date of Publication.	Total cases.	No. of cases operable.	Operability. %	Operative deaths.	Operative Mortality. %
<i>Perineal and Sacral Operations.</i>						
<i>England.</i>						
Cripps ...	1911	—	109	—	8	7·3
J. W. Smith ...	1911	?65	31	?50	1	2·2
Paul ...	1911	—	28	—	2	7·1
Swinford						
Edwards ...	1905	—	40	—	3	7·5
Gabriel ...	1925	280	143	50	22	15·4
Mummery ...	1926	—	200	—	17	8·5
Miles ...	1910	—	59	—	1	1·6
Morton ...	1908	—	34	—	4	11·7
Sinclair						
White ...	1912	?65	32	?50	6	18·7

APPENDIX I—continued.

Author.	Date of Publication.	Total cases.	No. of censes operable.	Operability. %	Operative deaths.	Operative Mortality. %
<i>Perineal and Sacral Operations.</i>						
<i>France.</i>						
Hartmann ...	1908	—	49	—	7	14·2
Boeckel ...	1897	—	50	—	6	12·0
Piollet ...	1913	—	12	—	2	16·6
Savariaud ...	1924	—	14	—	1	7·6
<i>United States.</i>						
J. Hartwell ...	1905	—	46	—	12	26·0
Fischelj ...	1924	32	18	56	2	11·6
Lynch ...	1918	?505	303	?60	48	16·0
Mayo ...	{ 1910 1915	— 481	118 312	— 64·9	20 33	17·8 10·6
<i>Belgium.</i>						
Depage ...	1902	—	30	—	6	20·0
Gallet ...	1897	—	11	—	5	45·4
<i>Switzerland.</i>						
Fischer ...	1877	—	14	—	6	42·8
Viuchoud ...	1910	125	40	32	8	20·0
Stierlin ...	1882	40	20	50	2	10·0
Christen ...	1897	49	24	49	1	4·2
Arnd ...	1890	123	35	28·5	10	28·6
Du Pan ...	1904	—	48	—	10	20·8
<i>Germany.</i>						
Petermann ...	{ 1903 1906	— 59	43 42	— 70·9	14 2	32·5 4·7
Rotter ...	1910	—	103	—	9	9·0
Wolff ...	1900	—	125	—	40	32·0
Eichhoff ...	1920	1,015	326	31·9	80	24·5
Csesch ...	1896	109	66	60·5	17	25·7
Kupferle ...	1902	—	238	—	28	11·8
Heuck ...	1882	43	25	58·1	1	4·0
Levinsohn ...	1885	27	16	59·2	1	6·3
Schmidt ...	1891	—	68	—	9	13·2
Schneider ...	1899	115	53	46	10	18·8
Wendel ...	1899	126	95	75·4	21	22·1
Hildebrand ...	1887	88	54	61·4	22	40·7
Kraske ...	{ 1889 1896	— 68	29 48	— 70	10 5	34·5 10·4
Gehler ...	1907	231	179	77·5	37	20·7
Kroll ...	1923	119	69	58	14	20·2
Prutz ...	1901	—	45	—	5	11·1
Richter ...	1906	—	64	—	4	6·3
Vogel ...	1901	—	48	—	13	27·1
<i>Hungary.</i>						
Herczol ...	1908	—	82	—	2	14·6
Matolay ...	1922	141	106	75·2	15	14·2

APPENDIX I—*continued.*

Author.	Date of Publication.	Total cases.	No. of cases operable.	Operability. %	Operative deaths.	Operative Mortality. %
<i>Perineal and Sacral Operations.</i>						
<i>Austria.</i>						
Foderl ...	1894	63	49	77·8	17	34·6
Pichler ...	1900	—	119	—	10	8·4
Zinner ...	1908	—	201	—	34	16·8
Mandl ...	1920	—	234	—	33	14·1
Frank ...	1891	—	38	—	5	12·8
Korbl ...	1912	—	204	—	28	13·6
Lorenz ...	1901	—	133	—	17	12·7
<i>Czecho-Slovakia.</i>						
Lieblein ...	1900	98	47	47·9	9	19·1
Funke ...	1896	—	146	—	33	22·5
<i>Scandinavia.</i>						
Bull ...	1918	71	44	62	5	11·4
Lund ...	{ 1916	42	22	52	2	9·1
	{ 1918	—	104	—	15	14·4
Lindstrom ...	1918	49	23	46·9	4	17·3
<i>Combined Operations.</i>						
<i>England.</i>						
Miles ...	{ 1925	587	172	29·3	—	—
	{ 1926	—	*116	—	29	25·0
<i>France.</i>						
Okinczye ...	1924	—	12	—	2	16·6
Gouilloud ...	1907	—	12	—	1	8·3
Schwartz ...	1923	—	11	—	3	27·2
Villard and Ricard ...	1925	—	†10	—	3	30·3
<i>United States.</i>						
J. A. Blake ...	1921	—	16	—	2	12·5
W. J. Mayo ...	1906	—	26	—	7	26·9
<i>Germany.</i>						
Rotter ...	1910	—	25	—	11	44·0
Goepel ...	1912	—	21	—	3	14·2
<i>Austria.</i>						
Moskowicz ...	1909	—	16	—	4	25·0

* Of these 116 cases only 42 have been considered in the report, as the full series was published too late for inclusion. Of the 42 cases considered 17 died from operation, giving an operative mortality of 40·5 per cent.

† All cases of "abdomino-transanal" operation.

APPENDIX II.

Survival after Radical Operation.

TABLE 31.

(1890 *inclusive onwards.*)

Country and Author.	Entrants	Died under 3 years			Lost.	Alive under 3 yrs.	Net entrants*	Alive at 3 yrs.
		of operation.	of other cause.	of cancer				
<i>England.</i>								
Cripps ...	96	7	1	21	7	17	71	43
Smith ...	31	7	—	4	—	14	17	6
Paul ...	28	2	1	12	—	4	23	9
Edwards ...	60	3	—	6	—	41	19	10
Mummery ...	200	17	5	43	6	44	145	85
Morton ...	34	4	1	9	10	6	17	4
White ...	32	6	1	14	—	—	31	11
TOTALS ...	481	46	9	109	23	126	323	168
<i>France.</i>								
Hartmann ...	49	7	1	5	23	5	20	8
Savariaud ...	14	1	—	—	4	3	7	6
Schwartz ...	11	3	—	1	1	5	5	1
Piollet ...	12	2	1	2	—	5	6	2
Villard and Ricard ...	10	3	—	2	1	—	9	4
TOTALS ...	96	16	2	10	29	18	47	21
<i>America.</i>								
Tuttle ...	87	13	—	15	9	25	53	25
Hartwell ...	46	12	—	11	—	17	29	6
Blake ...	16	2	—	2	7	—	9	5
Fischel ...	18	3	2	3	4	3	9	3
Russell ...	45	16	—	3	12	2	31	12
TOTALS ...	212	46	2	34	32	47	131	51
<i>Belgium.</i>								
Depage ...	30	6	—	16	—	2	28	6
<i>Switzerland.</i>								
Christen ...	24	1	—	16	—	2	22	5
Du Pan ...	48	10	1	17	—	10	37	10
TOTALS ...	72	11	1	33	—	12	59	15

* See footnote to Table 9, p. 19.

APPENDIX II—*continued.*

Country and Author.	Entrants	Died under 3 years			Lost.	Alive under 3 yrs.	Net entrants.	Alive at 3 yrs.
		of operation.	of other cause.	of cancer				
<i>Germany.</i>								
Petermann	85	16	5	15	—	28	52	21
Oehler ...	179	37	—	86	—	—	179	56
Richter ...	60	4	—	24	2	6	52	24
Wolff ...	125	40	—	42	18	3	104	22
Vogel ...	48	13	—	12	—	17	31	6
TOTALS ...	497	110	5	179	20	54	418	129
<i>Austria.</i>								
Foderl ...	49	17	3	11	—	16	30	2
Pichler ...	100	8	—	34	16	17	67	25
Zinner ...	201	34	3	69	14	35	149	46
Mandl ...	439	51	—	140	83	24	332	141
Lorenz ...	120	16	5	34	13	25	77	27
TOTALS ...	909	126	11	288	126	117	655	241
<i>Czecho-Slovakia.</i>								
Lieblein ...	47	9	3	15	4	12	28	4
GRAND TOTALS	2,344	370	33	684	234	388	1,689	635

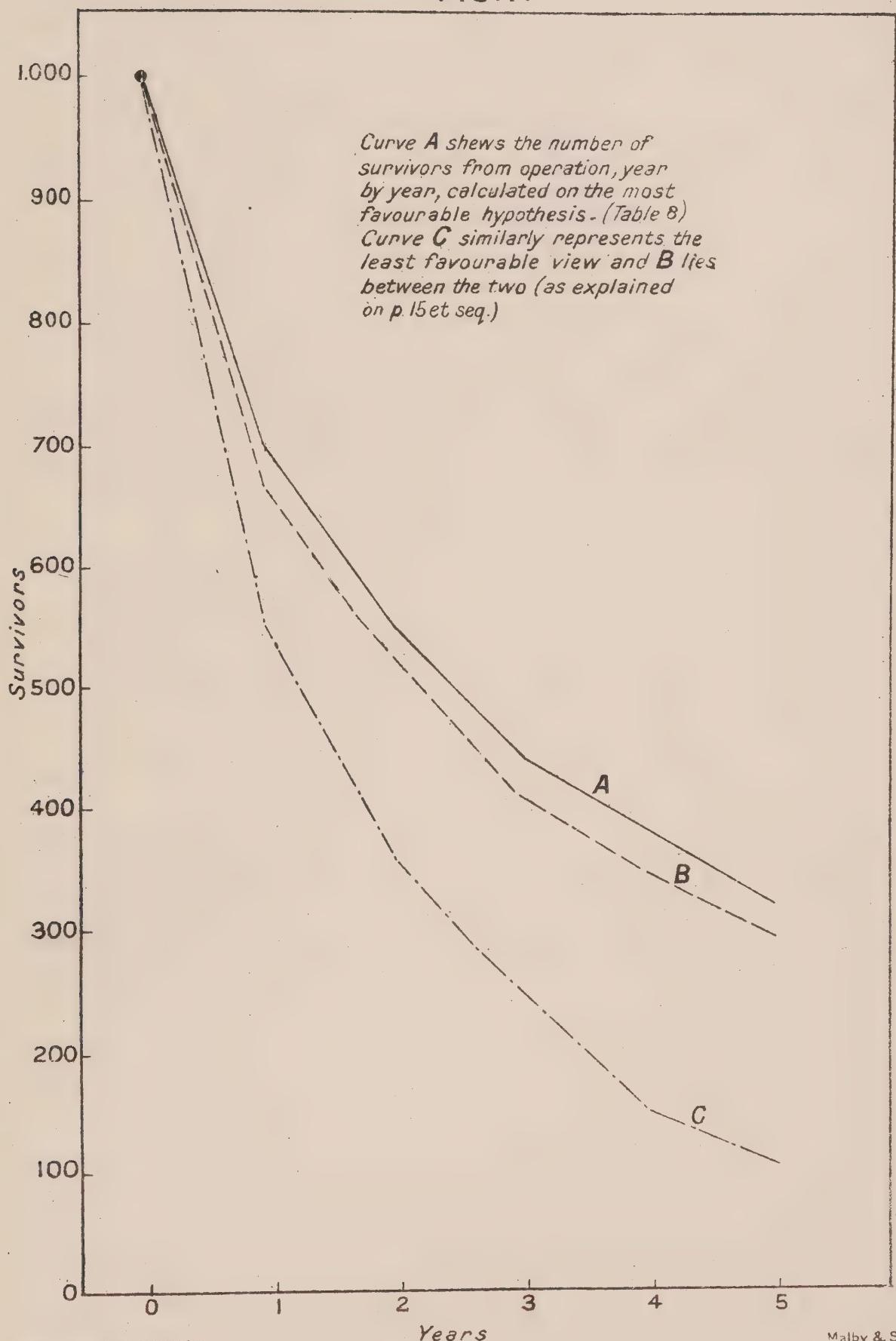
TABLE 32.
Radical Operations (before 1890 included).

Author.	Year 0.		Year 1.		Year 2.		Year 3.		Year 4.	
	Living and lost during.	Alive begin- ning.								
Cripps ...	19	17	109	73	3	55	3	2	2	37
Smith ...	9	10	31	12	2	9	0	1	1	4
Paul ...	4	0	13	3	1	6	0	0	0	5
Edwards ...	5	5	40	14	3	4	1	2	1	1
L. Mummery	22	8	200	22	3	15	1	2	7	67
Hartmann ...	7	24	49	18	1	17	1	2	1	6
Boeckel ...	14	16	50	4	3	130	9	8	7	14
Piollet ...	3	2	12	1	0	0	0	0	0	7
Savariaud	1	6	14	0	1	3	0	1	1	1
Schwartz ...	3	6	11	1	0	0	0	0	0	4
Villard and										1
Ricard	4	10	9	0	0	5	1	2	1	1
Tuttle ...	17	87	15	8	11	61	3	8	0	25
Hartwell ...	17	46	16	6	1	14	1	2	1	2
Blake ...	3	3	3	2	0	6	1	0	0	5
Fischel ...	3	17	16	0	0	11	1	4	0	1
Russell ...	16	45	0	2	0	1	1	1	0	9
Christen ...	8	0	24	7	1	16	1	2	0	2
Arnd ...	12	3	35	1	1	20	1	1	0	12
Du Pan ...	17	2	48	5	1	29	3	2	1	7
Petermann	29	22	85	4	1	34	9	2	1	12
Wolff ...	55	18	125	18	1	52	2	2	2	13
Csesch ...	33	7	66	6	1	26	1	2	2	4

TABLE 32—*continued.*

Author.	Year 0.				Year 1.				Year 2.				Year 3.				Year 4.			
	Dead during	Living and lost during	Alive beginning	Dead during	Living and lost during	Alive beginning	Dead during	Living and lost during	Alive beginning	Dead during	Living and lost during	Alive beginning	Dead during	Living and lost during	Alive beginning	Dead during	Living and lost during	Alive beginning		
Kupferle	72	11	238	49	12	155	25	94	14	7	62	3	45	8	0	0	0	45		
Schneider	20	7	53	7	1	26	5	18	3	4	2	1	2	2	0	0	0	5		
Wendel	49	4	95	12	0	42	10	30	3	0	2	1	2	1	0	0	0	17		
Hildebrand	32	7	54	2	3	15	5	2	2	2	19	1	12	2	1	2	2	4		
Kraske	19	7	77	25	7	51	7	35	4	2	9	4	26	3	2	1	1	10		
Richter	14	5	64	9	1	45	7	22	2	2	5	0	26	6	0	0	0	18		
Vogel	19	7	48	6	7	22	1	2	1	2	9	5	26	1	0	0	0	1		
Foderl	26	11	49	4	3	12	2	18	11	5	5	1	26	7	1	2	2	16		
Pichler	16	23	119	15	10	80	10	117	13	13	15	3	16	45	7	3	3	26		
Zinner	67	17	201	27	17	17	17	117	13	13	0	80	5	62	7	5	3	—		
Mandl	69	40	234	27	18	125	13	125	13	8	42	7	27	5	0	0	0	—		
Lorenz	35	31	131	14	9	65	8	7	7	1	3	1	4	1	1	1	1	15		
Lieblein	20	10	47	5	4	17	1	17	1	1	8	4	4	0	0	0	0	2		
TOTALS	759	373	2,543	301	187	1,411	175	111	923	87	164	87	637	57	38	38	386	386		

FIG. I.



Method of calculating average length of life after operation.

From the figures in Table 8A calculated according to method B and indicating the fate of 1,000 persons up to the end of five years the total number of years lived by them up to the end of 5 years is derived as follows :—

Alive beginning Year 0.	Alive beginning Year 1.	Dead during Year 0.	Died at operation.	Lived half year on average.	Total years lived.
1,000	678	322	185 (= 18.46% approx.)	137	68.5

Similarly :

Alive beginning Year 1.	Alive beginning Year 2.	Dead during Year 1.	Lived one and half years on average.	Total years lived.
678	523	155	155	= 232.5

and again :

$$\begin{aligned}
 \text{Total years lived up to end of Year } 2 &= 105 \times 2\frac{1}{2} = 272.5 \\
 \text{, , , , , , , , } 3 &= 66 \times 3\frac{1}{2} = 231 \\
 \text{, , , , , , , , } 4 &= 55 \times 4\frac{1}{2} = 247.5 \\
 \text{, , , , , , , , } 5 &= 297 \times 5 = 148.5 \\
 &\qquad\qquad\qquad \text{Total years lived} = 2,537.0
 \end{aligned}$$

That is, on an average, each person had 2.53 years of life after operation up to the end of the fifth year.

In the same manner the " Total years lived " up to the end of the fifth year in respect of Greenwood's Natural Duration table modified (*v. p. 24*) may be calculated. The figure obtained is 1.5915 or the 1,000 persons live altogether 1591.5 years on the average. The benefit to patients radically operated upon is 946 years, or 0.9 per patient, *i.e.*, an advantage of about 59 per cent. over the untreated.

APPENDIX III.
Ages of Patients and Types of Operation.

TABLE 33.

Age distribution for the two sexes of 1,312 patients undergoing operations of three types.

Age Group.	10-19		20-29		30-39		40-49		50-59		60-69		70-79		80-89		Total.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
No. in this group...	1	0	7	5	34	31	66	59	122	78	96	53	28	10	2	0	50 356 236
Percentage of total number in this group ...	0.3	0.3	2.0	2.1	9.5	13.1	18.5	25.0	34.3	33.1	26.9	22.5	7.9	4.24	0.6		100 100
Number in this group ...	1	0	14	15	27	38	83	67	129	85	87	42	23	3	1	0	365 250
Percentage of total number in this group ...	0.3	0.3	3.8	6.0	7.4	15.2	22.7	26.8	35.4	34.0	23.8	16.8	6.3	1.2	0.3		100 100
Number in this group ...	0	1	3	2	6	7	13	15	23	8	16	5	5	1	0		66 39
Percentage of total number in this group ...	4.5	5.1	9.1	17.9	19.7	38.4	34.9	20.5	24.2	12.8	7.6	2.6					100 100
Combined.																	

These data are not numerically identical with those in Tables 10, 11 and 12 on account of the information with regard to age being deficient.

APPENDIX IV.

Results of Resections and Amputations (v. p. 34).

TABLE 34.

Resections.

Year.	Dead.	Living and lost.	Alive beginning.		Probability of dying. B.	Probability of surviving. B.
			A.	B.		
0	238	100	682	632	$\frac{238}{632} = .3765$	.6235
1	92	58	344	315	$\frac{92}{315} = .2920$	.7080
2	43	33	194	1,775	$\frac{43}{1775} = .2422$	.7578
3	17	30	118	103	$\frac{17}{103} = .1650$	.8350
4	7	11	7	655	$\frac{7}{655} = .1068$	.8932
5	3	12	53	97	$\frac{3}{97} = .0638$	.9362
					$\frac{47}{47}$	

Amputations.

0	202	88	622	578	$\frac{202}{578} = .3494$	.6506
1	80	39	332	312.5	$\frac{80}{312.5} = .2560$	.7440
2	49	24	213	201	$\frac{49}{201} = .2437$	.7563
3	30	18	140	131	$\frac{30}{131} = .2290$	.7710
4	10	4	92	90	$\frac{10}{90} = .1111$	.8889
5	9	10	78	73	$\frac{9}{73} = .1233$	.8767
					$\frac{73}{73}$	

TABLE 35.

Shewing frequency of resections and amputations by countries (v. p. 34).

Country and Author.	Total No. of radical operations.	Resections.	Amputations.	Others.
<i>England.</i>				
Cripps ...	107	—	101	6
Gabriel ...	143	—	143	(Abdominal)
Smith, J. W. ...	31	6	8	17 (5 combined operations)
	281	6	252	23

TABLE 35—*continued.*

Country and Author.	Total No. of radical operations.	Resections.	Amputations.	Others.
<i>America.</i>				
Hartwell ...	46	18	25	3
<i>Switzerland.</i>				
Stierlin ...	20	6	8	6
Christen ...	24	19	4	1
Arnd ...	35	5	19	11
Du Pan ...	48	3	30	15
	127	33	61	33
<i>Germany.</i>				
Petermann ...	85	45	40	
Rotter ...	25	24	1	
Wolff ...	125	65	60	
Eichhoff ...	326	199	113	14
Kupferle ...	238	57	142	39
Schneider ...	53	30	11	12
Wendel ...	95		38	57
Hildebrand ...	54	29	7	18
Kraske ...	77	51	9	17
Oehler ...	179	117	35	27
Kroll ...	19	19	0	
Prutz ...	45	15	29	1
Richter ...	64	28	35	1
Vogel ...	48	31	14	3
	1,433	710	534	189
<i>Austria.</i>				
Moskowicz ...	16	10	6	
Foderl ...	48	28	20	
Pich'er ...	96	53	1	42
Zinner ...	201	79	15	107
Mandl ...	500	205	244	51
Korbl ...	204	65	118	21
Lieblein ...	46	22	24	(16 combined)
	1,111	462	428	221
<i>Scandinavia.</i>				
Bull ...	44	20	20	4
Lund ...	22	2	19	1
Borelius ...	104	35	52	(combined) 17 (5 combined)
	168	57	91	22

APPENDIX V.

Influence of Age on Survival.

TABLE 36.

Showing the expected numbers of survivors 1, 2, 3, 4, 5 and 6 years respectively after operation.

Years after operation.	20-29		30-39		40-49		50-59		60-69		70-79	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
0	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
1	679 (± 88.3)	(± 113.1) 487	729 (± 57.9)	(± 47.5) 802	712 (± 37.9)	(± 42.2) 718	646 (± 29.2)	(± 41.1) 702	520 (± 37.7)	(± 52.9) 528	500 (± 77.1)	(± 111.8) 826
2	551 (± 97.5)	(± 116.0) 348	456 (± 72.2)	(± 61.2) 616	546 (± 43.7)	(± 49.8) 541	427 (± 31.9)	(± 47.5) 497	361 (± 37.6)	(± 53.9) 462	288 (± 75.4)	(± 137.5) 723
3	446 (± 103.4)	(348)	285 (± 71.3)	(± 66.2) 495	403 (± 46.0)	(± 52.3) 459	316 (± 31.6)	(± 48.4) 395	261 (± 36.0)	(± 54.8) 385	250 (± 74.6)	(± 158.7) 602
4	387 (± 105.4)	209	199 (± 64.6)	(± 66.5) 486	353 (± 46.7)	(± 54.7) 405	271 (± 31.2)	(± 48.6) 330	223 (± 35.4)	(± 39.3) 260	(200)	(± 92.5) 301
5	322 (± 105.6)	(209)	169 (± 61.7)	(± 72.4) 364	308 (± 47.2)	(± 56.7) 381	257 (± 31.3)	(± 48.5) 315	173 (± 35.1)	(260)	187	?
6	315 (± 125.2)	?	?	(± 47.4)	277 (± 60.2)	(± 47.2)	205 (± 30.0)	?	143 (± 34.8)	(260)	?	?

(Probable errors are in brackets, with \pm sign, and either immediately above or below the numbers to which they refer.)

APPENDIX VI.

Influence of Sex on Survival (*v. p. 22*).

TABLE 37.

Males.

Immediate mortality—166 cases out of 847 = 19·95 %.

Year.	Dead during.	Living and lost.	Alive beginning		Probability of dying.	Probability of surviving.
			A.	B.		
0	295	114	847	790	$\frac{295}{790} = .3734$	.6266
1	124	64	438	406	$\frac{124}{406} = .3054$	.6946
2	62	37	250	231·5	$\frac{62}{231·5} = .2678$	.7322
3	21	25	151	138·5	$\frac{21}{138·5} = .1516$	.8484
4	15	12	105	99	$\frac{15}{99} = .1515$	.8485
5	13	9	78	73·5	$\frac{13}{73·5} = .1768$	.8232

Females.

Immediate Mortality = 83 cases out of 505 = 16·43 %

0	154	72	505	469	$\frac{154}{469} = .3284$	.6716
1	58	41	279	258·5	$\frac{58}{258·5} = .2244$	.7756
2	31	25	180	167·5	$\frac{31}{167·5} = .1851$	.8149
3	22	27	124	110·5	$\frac{72}{110·5} = .1991$	.8009
4	8	11	75	69·5	$\frac{8}{69·5} = .1151$	.8849
5	1	13	56	49·5	$\frac{1}{49·5} = .0202$	.9798

APPENDIX VII.

Influence of Position of Growth on Survival.

In this Appendix growths have been grouped according to (1) the distances of their lower edges from the anal margin and (2) their position on the circumference of the gut wall.

The grouping in many cases has been guesswork because the descriptions in the reports of cases are indefinite. It is, however, probably sufficiently accurate on the whole for purposes of comparison.

The position of the lower edge of the growth does not of course indicate in itself the extent of the disease above it. It is, however, mostly used in describing the clinical signs because the nature of the growth above the lower edge can often only be surmised.

For the second grouping three classes of growths have been taken, viz., those posterior, those anterior and those annular in the walls of the gut. Again the classification of a particular growth is only approximately accurate because some of the posterior growths may involve one or both sides, similarly the anterior ones are not all confined to the anterior wall and the annular growths may include growths which are not quite, but almost completely, annular. The classification probably suffices for comparative purposes.

TABLE 38.

Expected number of survivors 1, 2, 3, 4, 5 and 6 years respectively after operation.

Years after operation.	I Where lower edge of cancer lies within $1\frac{1}{2}$ " of anal margin.	II Where lower edge lies between $1\frac{1}{2}$ " and $4\frac{1}{2}$ " from anal margin.	III Where lower edge lies $4\frac{1}{2}$ " and upwards from anal margin.
0	1,000	1,000	1,000
1	664 (± 21.0)	661 (± 15.6)	616 (± 34.6)
2	488 (± 23.7)	511 (± 17.4)	411 (± 38.4)
3	361 (± 24.3)	421 (± 18.1)	358 (± 38.9)
4	271 (± 23.9)	351 (± 18.5)	336 (± 39.7)
5	237 (± 23.8)	312 (± 18.8)	308 (± 40.9)
6	227 (± 23.8)	280 (± 19.1)	?

(Probable errors are in brackets.)

TABLE 39.

Shewing the effect of grouping according to position around the walls of the rectum.

	Males.	Females.
Number of posterior growths
,, , anterior
,, , annular

TABLE 40.

Expected number of survivors 1, 2, 3, 4, 5 and 6 years respectively after radical operation.

Year after operation.	Posterior growths.		Anterior.		Annular.	
	Males.	Females.	Males.	Females.	Males.	Females.
0	1,000	1,000	1,000	1,000	1,000	1,000
1	613 (± 61·9)	732 (± 69·2)	589 (± 51·1)	707 (± 61·7)	596 (± 38·6)	630 (± 48·3)
2	554 (± 64·7)	610 (± 80·2)	458 (± 54·0)	530 (± 71·2)	406 (± 40·9)	468 (± 52·8)
3	478 (± 69·0)	478 (± 85·8)	393 (± 55·5)	412 (± 72·2)	324 (± 40·8)	396 (± 53·6)
4	417 (± 72·7)	387 (± 90·4)	316 (± 56·3)	359 (± 72·3)	280 (± 40·7)	310 (± 54·0)
5	344 (± 75·9)		294 (± 56·8)	265 (± 70·6)	235 (± 41·8)	266 (± 54·7)
6	?		268 (± 57·2)		213 (± 43·3)	

(Probable errors are in brackets.)

APPENDIX VIII.

Influence of State of Fixity or Mobility of Growth on Survival.

In preparing the following tables only those patients have been included whose case-reports state definitely that the growth was either fixed or movable.

TABLE 41.

Males.

Year.	Dead during.	Living and lost.	Alive beginning.		Probability of dying B.	Probability of surviving B.
			A.	B.		

Growth said to be "fixed." Immediate mortality = 18.3%.

0	30	8	71	67	.4477	.5523
1	11	7	33	29.5	.3728	.6278
2	3	2	15	14	.2142	.7858
3	4	2	10	9	.4444	.5556
4	0	1	4	3.5	(.0000)	(1.000)
5	1	0	3	3	.3333	—
+2						

Growth said to be "movable." Immediate mortality = 20.9%

0	29	9	86	81.5	.3358	.6442
1	6	8	48	44	.1363	.8637
2	5	8	34	30	.1666	.8334
3	3	3	21	19.5	.1538	.8462
4	2	1	15	14.5	.1379	.8621
+12						

From which may be derived :—

TABLE 42.

Males.

Expected number of survivors 1, 2, 3, 4, 5 years respectively after operation.

Years after operation.	Survivors B.	
	Growth fixed.	Growth movable.
0	1,000	1,000
1	552 (\pm 60.7)	644 (\pm 51.5)
2	346 (\pm 62.1)	556 (\pm 55.5)
3	272 (\pm 66.5)	464 (\pm 59.8)
4	151 (\pm 58.2)	392 (\pm 63.1)
5	(151)	338 (\pm 65.0)

(Probable errors are in brackets.)

TABLE 43.

Females.

Year.	Dead during.	Living and lost.	Alive beginning.		Probability of dying B.	Probability of surviving B.
			A.	B.		
Growth said to be "fixed." Immediate mortality = 16·6%.						
0	20	8	48	44	.4545	.5455
1	8	1	20	19·5	.4102	.5898
2	1	4	11	9	.1111	.8889
3	1	0	6	6	.1616	.8384
4	1	0	5	5	.2000	.8000
5	0	2	4	3	(.0000)	—
	+2				.	.

Growth said to be "movable." Immediate mortality = 15·8%

0	24	14	101	94	.2553	.7447
1	10	7	63	59·5	.1681	.8319
2	11	2	46	45	.2444	.7556
3	2	7	33	29·5	.0678	.9322
4	3	3	24	22·5	.1333	.8667
5	0	2	18	17	(.0000)	(1·0000)

TABLE 44.

Females.

Expected number of survivors 1, 2, 3, 4, 5 years respectively after operation.

Years after operation.	Survivors.	
	Growth fixed. (48 cases).	Growth movable. (101 cases).
0	1,000	1,000
1	546 ($\pm 75\cdot 1$)	745 ($\pm 44\cdot 9$)
2	322 ($\pm 75\cdot 2$)	620 ($\pm 52\cdot 0$)
3	286 ($\pm 74\cdot 8$)	468 ($\pm 55\cdot 8$)
4	240 ($\pm 71\cdot 9$)	436 ($\pm 56\cdot 3$)
5	192 ($\pm 67\cdot 4$)	378 ($\pm 57\cdot 9$)

(Probable errors are in brackets.)

APPENDIX IX.

Results of radical operations in which bone was removed compared with those of radical operations in which no bone was removed.

The former group includes operations in which coccyx was resected temporarily or permanently as well as "sacral" operations, but does not include "combined" operations.

TABLE 45.

Radical operations in which some bone was removed.

Males.

Year.	Dead during.	Living and lost during.	Alive beginning.		Probability of dying B.	Probability of surviving B.
			A.	B.		
0	140	58	424	395	$\frac{140}{395} = .3544$	.6456
1	62	39	226	206.5	$\frac{62}{206.5} = .3002$	.6998
2	32	21	125	114.5	$\frac{32}{114.5} = .2794$	.7206
3	8	17	72	63.5	$\frac{8}{63.5} = .1259(8)$	.8740
4	8	7	47	43.5	$\frac{8}{43.5} = .1839$	.8161
5	3	4	22	20	$\frac{3}{20} = .1500$	.8500
	+15					

Females.

0	70	34	249	232	$\frac{70}{232} = .3016$	.6984
1	27	26	145	132	$\frac{27}{132} = .2045$	.7955
2	15	19	92	82.5	$\frac{15}{82.5} = .1818$	.8182
3	11	11	58	52.5	$\frac{11}{52.5} = .2095$	.7905
4	3	6	36	33	$\frac{3}{33} = .0909$	.9091
5	0	9	27	22.5	$\frac{0}{22.5} = (.0000)$	(1.0000)
	+18					

From which may be derived :—

TABLE 46.

Expected number of survivors, 1, 2, 3, 4, 5 or 6 years respectively after operation.

Years after operation.	Males.	Females.
0	1,000	1,000
1	646 (± 24.1)	698 (± 30.1)
2	452 (± 26.6)	556 (± 34.3)
3	326 (± 26.9)	455 (± 36.7)
4	285 (± 27.2)	359 (± 38.6)
5	232 (± 27.7)	327 (± 39.4)
6	197 (± 29.9)	?

TABLE 47.

*Radical operations in which no bone was removed.**Males.*

Year.	Dead during.	Living and lost during.	Alive beginning.		Probability of dying B.	Probability of surviving B.
			A.	B.		
0	73	36	215	197	$\frac{73}{197} = .3705$	.6295
1	24	15	106	98.5	$\frac{24}{98.5} = .2436$	.7564
2	12	8	67	63	$\frac{12}{63} = .1904$	.8096
3	4	8	47	43	$\frac{4}{43} = .0932$	.9070
4	4	2	35	34	$\frac{4}{34} = .1176$	.8824
5	4	3	29	27.5	$\frac{4}{27.5} = .1454$	.8546
	+22	+32			$\frac{27.5}{27.5}$	

Females.

0	40	24	168	156	$\frac{40}{156} = .2564$	.7436
1	20	9	104	99.5	$\frac{20}{99.5} = .2010$	.7990
2	4	2	75	74	$\frac{4}{74} = .0540$	.9459
3	11	16	69	61	$\frac{11}{61} = .1803$	.8197
4	1	5	42	39.5	$\frac{1}{39.5} = .0253$	.9747
5	1	3	36	34.5	$\frac{1}{34.5} = .0289$	.9711
	+32				$\frac{34.5}{34.5}$	

From which may be derived :—

TABLE 48.

Expected numbers of survivors 1, 2, 3, 4, 5 or 6 years respectively, after operation.

Years after operation.	Males. B.	Females. B.
0	1,000	1,000
1	630 (± 34.3)	744 (± 35.0)
2	476 (± 37.7)	594 (± 40.9)
3	385 (± 38.5)	562 (± 41.7)
4	350 (± 38.9)	461 (± 44.0)
5	309 (± 39.4)	449 (± 44.4)
6	264 (± 39.6)	436 (± 45.0)

APPENDIX X.
Alleged Duration of Disease in Relation to Site of Growth.

TABLE 49.

Position of lower edge of growth.	Alleged Duration of Disease in months.										Totals.									
	0-3			3-6			6-9			9-12	12-18	18-24	24-30	More than 30						
	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.		
Low	22	9.6	38	16.6	45	19.7	30	13.1	42	18.4	15	6.5	24	10.0	14	6.1	230	100
Middle	32	9.4	79	23.1	56	16.4	43	12.6	74	21.6	16	4.7	23	6.7	19	5.5	342	100

Note.—The classification of growths here employed is that given on pp. 3, 4.

APPENDIX XI.

Deaths Month by Month during First Year following Perineal or Sacral Operation.

TABLE 50.

—	Total perineal operations.	Deaths occurring up to beginning of											
		2nd mth	3rd mth	4th mth	5th mth	6th mth	7th mth	8th mth	9th mth	10th mth	11th mth	12th mth	
MALES.													
Numbers	361	73	3	1	8	1	5	7	3	4	9	11	
Percentages	100	20·2	0·8	0·3	2·2	0·3	1·4	1·9	0·8	1·1	2·5	3·0	
FEMALES.													
Numbers	241	32	1	1	3	3	1	2	4	3	2	2	
Percentages	100	13·3	0·4	0·4	1·2	1·2	0·4	0·8	1·7	1·2	0·8	0·8	
TOTALS.													
Numbers	602	105	4	2	11	4	6	9	7	7	11	13	
Percentages	100	17·4	0·7	0·3	1·8	0·7	1·0	1·5	1·2	1·2	1·8	2·1	

TABLE 51.

—	Total sacral operations.	Deaths occurring up to beginning of											
		2nd mth	3rd mth	4th mth	5th mth	6th mth	7th mth	8th mth	9th mth	10th mth	11th mth	12th mth	
MALES.													
Numbers	430	65	6	3	4	12	5	3	6	2	6	2	
Percentages	100	15·1	1·4	0·7	0·9	2·8	1·2	0·7	1·4	0·5	1·4	0·5	
FEMALES.													
Numbers	266	42	7	5	3	3	7	1	2	1	3	4	
Percentages	100	15·8	2·6	1·9	1·1	1·1	2·6	0·3	0·8	0·3	1·1	1·5	
TOTALS.													
Numbers	696	107	13	8	7	15	12	4	8	3	9	6	
Percentages	100	15·4	1·9	1·1	1·0	2·2	1·7	0·6	1·1	0·4	1·3	0·9	

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